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MAYEKAWA

Reciprocating Compressor
M Series Operation Manual
4M/6M/8M/62M/62M-FM

CAUTION

Before operating, inspecting, or servicing the compressor, read this manual thoroughly to fully understand the contents.

Keep this operation manual in a safe, designated place for future reference whenever the manual is needed.

MYCOM MAYEKAWA MFG. CO., LTD.
3–14–15 Botan Koto-ku, Tokyo 135-8482, Japan

Preface

Thank you for having purchased our M series reciprocating compressor (hereinafter indicated as "this machine").

This operation manual (hereinafter indicated as "this manual") describes safety information, operational and maintenance procedures in detail for safe and effective use of this product.

Before installing or using this product, make sure you read this manual.

Keep this manual in a safe place near the product for quick reference.

Warranty and Disclaimer

Warranty Clauses

If malfunctions or damages occur under proper usage (conditions) following documents such as operation manual or drawings of this product, or, if MAYEKAWA judges that malfunctions or damages are related to design or manufacture of the product, and if the malfunctions or damages are within the warranty period, we will repair or replace the product without any charges.

The warranty period is "12 months from factory shipment of this product".

MAYEKAWA is not liable for production or man made disaster compensation due to malfunction or damage of this product.

Disclaimer Clauses (Exclusion of Warranty Clauses)

Although MAYEKAWA warrants the clauses mentioned above, the following clauses are exempted.

- Malfunction or damage of this product caused by natural disaster, or other accidental forces (such as fire, thunderbolt, windstorm, intense rainfall, flood, tidal wave, earthquake, land subsidence, e.t.c).

- Malfunction or damage caused by misusage described below.
  - Malfunction, damage, or defect of this product due to abnormal or improper use (such as storing this product for middle to long term outside the building or in locations subject to high temperatures and high humidity, unexpected inspections, tests, operations, and excessive repetition start-up/stoppage of the product.)
  - Malfunction or damage caused by devices or equipments not provided by MAYEKAWA including operation control methods of those devices.
  - Malfunction or damage caused by refrigerants, gases, or refrigerant oils, and operating conditions (design conditions) not approved for this product.
  - Malfunction or damage caused by maintenance or inspection not recommended by MAYEKAWA.
  - Malfunction or damage caused by parts that are not Mayekawa genuine.
  - Malfunction or damage caused by remodeling the product without approval of MAYEKAWA.
  - Malfunction or damage caused by unexpected misusage

Important Information

Intended Use of the Product

This product is a universal screw compressor intended for refrigeration, cold storage, and air conditioning. Do not use the product for any other purposes that are not intended for or which depart from the specifications. For specifications of this product, refer to "2.2 Compressor Specifications".

When performing maintenance use qualified refrigeration personnel.

Important Information for Safe Use of the Product

Although MAYEKAWA has paid a lot of attention to safety measures for this product, all hazards including potential hazards caused by human errors, or due to environmental conditions can not be anticipated.

There are guidelines that must be observed for operating this product. However, the warnings in this manual and safety labels on the product are not all inclusive. When operating this product, pay extreme caution on personnel safety as well as on items described in this manual.

Important rules for safety work with the product that apply to all workers including managers and supervisors are listed below.

Before using this product, carefully read and fully understand the contents written in this manual and pay attention to safety.

- Operation, maintenance, and inspection of this product should be performed by qualified personnel educated about the fundamentals of the product and trained about hazards involved and measures to avoid danger.
- Do not allow any person other than those educated on the fundamental expertise of the product and trained about hazards involved and measures to avoid dangers to approach the product while it is operating or during maintenance.
- Observe all related federal/national and local codes and regulations.
- To prevent accidents, do not carry out any operation or maintenance other than those described in this manual, or use the product for any unapproved purpose.
- Replace the parts with the MAYEKAWA genuine parts.
- Not only workers but also managers should actively participate safety and health activities in the workplace to prevent accidents.

Observe the following precautions when performing maintenance work on electrical control.

- Electrical maintenance of the product must be performed by certified/qualified personnel and only those educated about the electrical control of the product.
- Before servicing or inspecting the electrical equipments or devices, turn "OFF" the motor main power and control power, and perform lockout/tagout to prevent the power from being turned on during work.

Even when the motor main power and control power are turned "OFF", the product may be turned on if the power is supplied from outside the refrigeration system, cold storage, and air conditioning system. Make sure the power supply on the power source side is shut off, and perform lockout/tagout to prevent the product from being turned on during work.

About This Manual

- This product may be modified without prior notice. Therefore, the appearance of actual machine may differ from the descriptions in this manual. If you have any questions contact your sales offices or service centers.
- This manual is in English. If any other language is required it is the customers responsibility to prepare a manual for safety education and operation instructions.
- This manual is copyrighted. Drawings and technical references including this manual shall not, in whole or part, be copied, photocopied, or reproduced into any electronic medium or machine-readable form without prior permission from MAYEKAWA.
- Photographs or drawings included in this manual may differ from the appearance of actual product.
- If this manual is lost or damaged, immediately place a purchase order to your local sales office or service center for a new manual. Using the product without the manual may result in safety issues.
- If you resell the product, never fail to attach this manual to the product.

Construction of This Manual

Title of section and chapter	Description details
Preface	Describes the outline of this manual and how to read this manual.
Warranty and Disclaimer	Describes clauses and coverage of warranty. Exclusion of warranty clauses is described as disclaimer.
Important Information	Describes important information related to the machine and this manual.
1. Safety	Describes safety information for the worker, safety rules for this machine, and management details regarding the work safety that is required for handling the machine.
2. Configuration and Specification of Compressor	Describes the main components of the machine, functional information, specification, and service limits.
3. Installation	Describes the installation procedure of the machine.
4. Operation of the Compressor and the System	Describes the precautions for operating the machine.
5. Maintenance	Describes sections and period for inspecting, and assembly and disassembly of this product.
6. Troubleshooting	Describes the methods of the machine in case of problem occurring during operation of the machine.
7. Related Document	Describes information such as illustrated parts breakdown and parts list.

How to Order MAYEKAWA Genuine Parts

Confirm the applicable parts in "7.1 Development View and Configuration Table of the Parts" of "Chapter 7, Related Document". And inform the “Product Name, Part Number, Part Name, and required quantity” to your local sales offices or service centers.

Inquiry

If you need further information or have any questions, please contact your local sales offices or service centers.

1. Domestic

Description	Address	Tel/Facsimile
Head office	〒135-8482 3–14–15 Botan Koto-ku, Tokyo	TEL:03-3642-8181 FAX:03-3643-7094
Moriya plant	〒302-0118 2000, Taysuzawa Moriya-shi, Ibaraki-pref	TEL:0297-48-1361 FAX:0297-48-5269
Hokkaido office	〒063-0803 2-5-1, 3-jyo Nijuuyonken Nishi-ku, Sapporo-city, Hokkaido	TEL:011-631-2052 FAX:011-631-2053
Tohoku office	〒983-0012 2-5-12, Ideka, Miyagino-ku, Sendai-shi, Miyagi-pref.	TEL:022-259-5211 FAX:022-259-5223
Hokushinetsu office	〒950-0925 Oyama-build. 303, 1-2-34, Bentenbashi-dori, Chuo-ku, Niigata-shi, Niigata-pref.	TEL:025-257-1626 FAX:025-286-6165
Kanto office	〒135-8482 3–14–15 Botan Koto-ku, Tokyo	TEL:03-3643-2886 FAX:03-3641-8468
Tokai office	〒422-8034 1-15-36, Takamatsu, Suruga-ku, Shizuoka-shi, Shizuoka-pref.	TEL:054-236-5350 FAX:054-236-5355
Chubu office	〒460-0002 2-9-6, Marunouchi, Naka-ku, Nagoya-shi, Aichi-pref.	TEL:052-218-3307 FAX:052-218-3308
Kansai office	〒553-0001 1-4-27, Ebie, Fukushima-ku, Osaka-shi, Osaka	TEL:06-4795-6000 FAX:06-4795-6033
Chugoku office	〒739-2117 2-3-40, Takayadai, Higashihiroshima-shi, Hiroshima-pref.	TEL: 082-491-1830 FAX: 082-491-1838
Shikoku office	〒761-8074 410-1, Otakamimachi, Takamatsu-shi, Kagawa-pref.	TEL:087-868-3400 FAX:087-868-3399
Kyushu office	〒810-0802 Fukuoka-fujiland-build. 10F, 2-3, Nakajima-cho, Nakasu, Hakata-ku, Fukuoka-shi, Fukuoka-pref.	TEL:092-262-0016 FAX:092-262-0115

2. Overseas

Description	Location	Telephone and facsimile No.
NORTH AMERICA		
MYCOM CANADA LTD. (VANCOUVER OFFICE)	UNIT 110, 6620 MCMILLAN WAY, RICHMOND, B.C., V6W 1J7, CANADA	TEL: (1) 604-270-1544 FAX: (1) 604-270-9870
MYCOM CANADA LTD. (TORONTO OFFICE)	1745 BONHILL ROAD, UNIT #6&7 MISSISSAUGA, ONTARIO, L5T 1C1, CANADA	TEL: (1) 905-564-0664 FAX: (1) 905-564-7614
MAYEKAWA U.S.A. INC. (HEAD OFFICE)	8750 WEST BRYN MAWR AVENUE, SUITE 190 CHICAGO, IL 60631, U.S.A.	TEL: (1) 773-516-5070 FAX: (1) 773-516-5071
MAYEKAWA U.S.A. INC. INDUSTRIAL REFRIGERATION DIVISION (MIAMI OFFICE)	7220 N.W. 32TH AVE., SUITE 303, MIAMI, FL 33166, U.S.A.	TEL: (1) 305-477-5741 FAX: (1) 305-477-5681
MAYEKAWA U.S.A. INC. INDUSTRIAL REFRIGERATION DIVISION (CHARLOTTE OFFICE)	15905 BROOKWAY DRIVE UNIT 4208 HUNTERSVILLE, NC 28078, U.S.A.	TEL: (1) 704-896-3632 FAX: (1) 704-896-3697

Description	Location	Telephone and facsimile No.
MAYEKAWA U.S.A. INC. INDUSTRIAL REFRIGERATION DIVISION (NASHVILLE OFFICE)	SUITE 203 BROOKSIDE LANDING 1550 N MT JULIET RD., MT JULIET, TN 37122, U.S.A	TEL: (1) 615-773-2859 FAX: (1) 615-758-7743
MAYEKAWA U.S.A. INC. INDUSTRIAL REFRIGERATION DIVISION (LA OFFICE, FACTORY)	19475 GRAMERCY PLACE, TORRANCE, CA 90501, U.S.A.	TEL: (1) 310-328-1362 FAX: (1) 310-782-6759
MAYEKAWA U.S.A. INC. INDUSTRIAL REFRIGERATION DIVISION (SEATTLE OFFICE)	2615 W CASINO ROAD, UNIT-3D, EVERETT, WA 98204, U.S.A.	TEL: (1) 425-348-3404 FAX: (1) 425-348-3419
MAYEKAWA U.S.A. INC. INDUSTRIAL REFRIGERATION DIVISION (MODESTO OFFICE)	4718 GREEN LEAF COURT, SUITE 5 MODESTO, CA 95356, U.S.A.	TEL: (1) 209-545-9752 FAX: (1) 209-545-3654
MAYEKAWA U.S.A. INC. INDUSTRIAL REFRIGERATION DIVISION (SAN FRANCISCO OFFICE)	1840 GATEWAY DRIVE, # 226 SAN MATEO, CA 94404, U.S.A.	TEL: (1) 650-378-1235 FAX: —
MAYEKAWA U.S.A.INC. INDUSTRIAL REFRIGERATION DIVISION (SAN ANTONIO OFFICE)	16825 IH 35 NORTH SELMA, TX 78154, U.S.A.	TEL: (1) 210-599-4536 FAX: (1) 210-599-4538
MAYEKAWA U.S.A. INC. INDUSTRIAL REFRIGERATION DIVISION (NY OFFICE)	303 SOUTH BROADWAY, SUITE 102 TARRYTOWN, NEW YORK 10591, U.S.A.	TEL: (1) 914-301-9770 FAX: (1) 914-332-0400
MAYEKAWA U.S.A. INC. INDUSTRIAL REFRIGERATION DIVISION (YORK OFFICE)	3395 FARMTRAIL ROAD YORK, PA 17406, U.S.A.	TEL: (1) 717-779-0138 FAX: (1) 717-779-0109
MAYEKAWA U.S.A.INC. MANUFACTURING DIVISION (SAN ANTONIO OFFICE, FACTORY)	16825 IH 35 NORTH SELMA, TX 78154, U.S.A.	TEL: (1) 210-599-4518 FAX: (1) 210-599-1788
MAYEKAWA U.S.A. INC. CHEMICAL PROCESS DIVISION	19475 GRAMERCY PLACE, TORRANCE, CA 90501, U.S.A.	TEL: (1) 310-328-6279 FAX: (1) 310-328-8487
MAYEKAWA U.S.A. INC. CHEMICAL PROCESS DIVISION (HUSTON OFFICE)	3222 PASADENA FREEWAY PASADENA, TX 77503, U.S.A.	TEL: (1) 281-447-2599 FAX: (1) 281-447-6623
EUROPE		
N.V.MAYEKAWA EUROPE S.A. (HEAD OFFICE, FACTORY)	LEUVENSESTEENWEG 605, 1930 ZAVENTEM, BELGIUM	TEL: (32) 2-757-9075 FAX: (32) 2-757-9023
N.V.MAYEKAWA EUROPE S.A. ZWEGNIEDEALASSUNG DEUTSHLANSD	NUERNBERGER STRASSE 118, 97076 WUERZBURG, DEUTSCHLAND	TEL: (49) 931-389388-0 FAX: (49) 931-359388-20
MAYEKAWA UK REPRESENTATIVE OFFICE	16 OAKHURST GARDENS, BEXLEYHEATH, KENT DA7 5JP, UNITED KINGDOM	TEL: (44) 1322-433558 FAX: (44) 1322-433164
MAYEKAWA. S.L.	CALLE MONTEVIDEO 5, NAVE 13 POL. INDUSTRIAL CAMPORROSO 28806 ALCALA DE HENARES, MADRID, SPAIN	TEL: (34) 91-830-0392 FAX: (34) 91-830-0397
MAYEKAWA EUROPE S.A. SUCCURSALE FRANCAISE	9, RUE MICHAEL FARADAY, 78180 MONTIGNY-LE-BRETONNEUX, FARNCE	TEL: (33) 1-30-58-26-00 FAX: (33) 1-30-58-19-37
MAYEKAWA MFG. CO., LTD. MOSCOW LIAISON OFFICE	HOUSE 3, FLAT 54, MYTNAYA ST, MOSCOW, 119049 RUSSIA	TEL: (7) 499-230-01-76 FAX: (7) 495-230-21-12
MYCOM INTERTEC AG	ROSENBERGSTRASSE 31, CH-6300 ZUG, SWITZERLAND	TEL: (41) 41-726-8626 FAX: (41) 41-726-8620
MAYEKAWA EUROPE S,A, DUBAI OFFICE	P.O.BOX.61349, LOB.11.NO.126, JEBEL ALI FREE ZONE, DUBAI, U.A.E.	TEL: (971) 4-887-2232 FAX: (971) 4-887-2238
MAYEKAWA BULGARIA REPRENSETATIVE OFFICE	94, HRISTO BOTEV STR. 1202, SOFIA, BULGARIA	TEL: (359) 2-8319002 FAX: (359) 2-8319002
MYCOM REFRIGERATION INDIA PVT.LTD.	#30 CENTRUM PLAZA, GOLF COURESE ROAD, SECTOR 53, GURAGAON, HARYANA, 122002, REPBLIV OF INDIA	TEL: (91) 12-4420-6616 FAX: (91) 12-4420-6618
MAYEKAWA AUSTRALIA PTY.LTD.	UNIT 2, 44 MCCAULEY STREET MATRAVILLE NSW 2036, AUSTRALIA	TEL: (61) 2-9695-7000 FAX: (61) 2-9695-7001

Description	Location	Telephone and facsimile No.
MAYEKAWA AUSTRALIA PTY. LTD.(NEW ZEALAND BRANCH)	30 TUI STREET OTAHUHU PO. BOX 12106 AUCKLAND NEWZELAND	TEL: (64) 9-276-2305 FAX: (64) 9-276-2306
ASIA		
P.T.MYCOM INDONESIA	GRAHA PRATAMA BUILDING, 9TH FLOOR JI. M. T. HARYONO KAV.15 JAKARTA 12810, INDONESIA	TEL: (62) 21-8370-9484 FAX: (62) 21-8370-9483
MAYEKAWA (M) SDN. BHD.	35-1, BLOCK D1, DATARAN PRIMA, JALAN PJU 1/41, KELANA JAYA, 47301 PETALING JAYA, SELANGOR, MALAYSIA	TEL: (60) 3-78051406 FAX: (60) 3-78051409
MYCOM PHILIPPINES CORP.	UNIT 2706 UNION BANK PLAZA MERALCO AVENUE CORNER ONYX St. ORTIGAS CENTER, PASIG CITY 1605, PHILIPPINES	TEL: (63) 2-706-0473 FAX: (63) 2-706-0475
MYCOM PHILIPPINES CORP. (GENARAL SANTOS OFFICE)	ROOM 4, LEAH DAPROZA BUILDING FISCAL DAPROZA AVENUE GENERAL SANTOS CITY 9500	TEL: (63) 83-552-3282 FAX: (63) 83-301-2698
MAYEKAWA SINGAPORE PTE.LTD.	6 TAGORE LANE SINGAPORE 787470	TEL: (65) 6451-1565 FAX: (65) 6451-4932
MYCOM INDUSTRY CO., LTD. (HEAD OFFICE)	1F., NO.2, SHIN JANN ROAD, CHIEN CHEN DIST., KAOHSIUNG, TAIWAN 80672, REP.OF CHINA	TEL: (886) 7-821-0886 FAX: (886) 7-821-4688
MYCOM INDUSTRY CO., LTD. CHEMICAL DEPARTMENT	1F., NO.2, SHIN JANN ROAD, CHIEN CHEN DIST., KAOHSIUNG, TAIWAN 80672, REP.OF CHINA	TEL: (886) 7-821-7709 FAX: (886) 7-821-9019
MYCOM INDUSTRY CO., LTD. TAIPEI BRANCH	10F-4, NO, 421, SONG-SHAN ROAD, TAIPEI, TAIWAN 11083, REP. OF CHINA	TEL: (886) 2-2727-9711 FAX: (886) 2-2759-8484
MYCOM INDUSTRY CO., LTD. TAICHUNG BRANCH	NO. 19, SEC.3, HUANJUNG RD., TAICHUNG, TAIWAN, REP. OF CHINA	TEL: (886) 4-2251-4128 FAX: (886) 4-2251-4129
MAYEKAWA CHINA INDUSTRIES CO., LTD.	ROOM 705, WISE LOGIC INTERNATIONAL CENTER, NO.66 NORTH SHANXI RD., SHANGHAI, 200041, CHINA	TEL: (86) 21-5116-8958 FAX:(86) 21-5116-8928
MAYEKAWA CHINA INDUSTRIES CO., LTD. QINGDAO OFFICE	ROOM 503, FULIN BUILDING NO.87 SOUTH FUZHOU ROAD, SOUTH DISTRICT, QINGDAO CITY, 266071, CHINA	TEL: (86) 532-8602-6169 FAX: (86) 532-8602-6269
MAYEKAWA MFG. CO., LTD BEIJING LIAISON OFFICE	NO.7B222 HANWEI PLAZA, NO.7 GUANGHUA ROAD, CHAOYANG DISTRICT, BEIJING 100004, CHINA	TEL: (86) 10-6561-7811 FAX: (86) 10-6561-1997
MAYEKAWA (THAILAND) CO., LTD.	2/3 MOO 14, 9TH FLOOR BANGNA TOWER BLDG., TOWER A, BANGNA-TRAD RD, K.M.6.5, BANGKAEW BANGPLEE, SAMUTPRAKARN 10540, THAILAND	TEL: (66) 2-751-9610 FAX: (66) 2-751-9565
MAYEKAWA (THAILAND) CO., LTD. TRANG BRANCH	1/7 TRANG-PALIAN RD., MUANG, TRANG 92000, THALAND	TEL: (66) 75-224-784 FAX: (66) 75-224-351
MAYEKAWA HOLDING (THAILAND) CO., LTD.	2/3 MOO 14, 9TH FLOOR BANGNA TOWER BLDG., TOWER A, BANGNA-TRAD RD, K.M.6.5, BANGKAEW BANGPLEE, SAMUTPRAKARN 10540, THAILAND	TEL: (66) 2-751-9610 FAX: (66) 2-751-9565
MAYEKAWA MFG.CO., LTD. HO CHI MINH CITY REPRESENTATIVE OFFICE	ROOM 305, 3FL, TOUI TRE TOWER, 60A HOANG VAN THU, WARD 9, PHU NHUAN DIST., HO CHI MINH CITY, VIETNAM	TEL: (84) 8-3997-5284 FAX: (84) 8-3997-5287

Description	Location	Telephone and facsimile No.
MAYEKAWA VIETNAM ONE MEMBER COMPANY LIMITED (MAYEKAWA VIETNAM)	ROOM 305, 3FL, TOUI TRE TOWER, 60A HOANG VAN THU, WARD 9, PHU NHUAN DIST., HO CHI MINH CITY, VIETNAM	TEL: (84) 8-3997-5284 FAX: (84) 8-3997-5287
MYCOM KOREA CO., LTD. HEAD OFFICE	JUYEON BUILDING 2F, SEOGYE-DONG 209, YONGSAN-KU, SEOUL, 140-710, REP.OF KOREA	TEL: (82) 2-796-1766 FAX: (82) 2-798-7715
MYCOM KOREA CO., LTD. CHANGWON FACTORY	PALYONG DONG 24-20, CHANGWON KYUNGSANGNAM-DO 641847, REP.OF KOREA	TEL: (82) 55-294-8678 FAX: (82) 55-299-7678
MYCOM KOREA CO., LTD. PUSAN BRANCH	TONG YOUNG SU SAN 6F, 763-20 KAMCHEON-DONG, SAHA-KU, PUSAN 604-806, REP.OF KOREA	TEL: (82) 51-242-3737 FAX: (82) 51-243-8542
MYCOM KOREA CO., LTD. GWANGJU BRANCH	970-6 WOLCHUL-DONG PUK-KU GWANGJU 500-460, REP. OF KOREA	TEL: (82) 62-973-8471 FAX: (82) 62-973-8475
LATIN AMERICA		
MAYEKAWA ARGENTINA S.A. (BUENOS AIRES OFFICE)	AV. VELEZ SARSFIELD 670/74 C1282 AFT-CAPITAL FEDERAL BUENOS AIRES, REPUBLICA ARGENTINA	TEL: (54) 11-4302-2791 FAX: (54) 11-4304-3015
MAYEKAWA ARGENTINA S.A. (PUERTO MADRYN OFFICE)	OFICINA PTO. MADRYN LEOPOLDO LUGONES 45 (U9129KDA)-PUERTO MADRYN PCIA DE CHUBUT REPUBLICA ARGENTINA	TEL: (54) 2965-475414 FAX: (54) 2965-475414
MYCOM PERU S.A.C.	CALLE LUIS PASTEUR 1490, LINCE, LIMA, PERU	TEL: (51) 1-441-8552 FAX: (51) 1-222-1543
MAYEKAWA CHILE S.A.C.el. (SANTIAGO OFFICE)	CORDILLERA No.331, MODULO D14, FLEX CENTER, PUERTO VESPUCIO, QUILICURA, SANTIAGO, CHILE	TEL: (56) 2-739-0202 FAX: (56) 2-739-2700
MAYEKAWA CHILE S.A.C.el. (CONCEPCION OFFICE)	ANIBAL PINTO No.215, OFICINA 403, CONCEPCION, CHILE	TEL: (56) 41-223547 FAX: (56) 41-212443
MAYEKAWA CHILE S.A.C.el. (PUERTO MONTT OFFICE)	BERNARDINO 1057 MODULO 6, PARQUE INDUSTRIAL SAN ANDRES PUERTO MONTT, CHILE	TEL: (56) 65-257570 FAX: (56) 65-288073
ANREC LTDA	TRANSVERSAL 93 NO.53-48 INTERIOR 37, PAQUE INDUSTRIAL EL DORADO, BOGOTO, COLOMBIA	TEL: (57) 1-224-3028 FAX: (57) 1-224-3203
MAYEKAWA DO BRASIL REF. LTDA.	RUA LICATEM 250, JARDIM FAZENDA RINCAO POLO INDUSTRIAL DE ARUJA-SP, CEP 07400-000, BRASIL	TEL: (55) 11-4654-8000 FAX: (55) 11-4654-8002
MAYEKAWA DO BRASIL LTDA. (BAHIA BRANCH)	RUA DR. JOSE PEROBA, 275 - SALA 902 EDIFICIO METROPOLIS - BAIRRO STIEPE, SALVADOR-BA, CEP 41770-2325, BRASIL	TEL: (55) 71-3341-0737 FAX: —
MAYEKAWA DO BRASIL LTDA. (BELO HORIZONTE BRANCH)	AV. BARAO HOMEM DE MELLO, 4386 – S 401 ED.EMYR SOARES - BAIRRO ESTORIL BELO HORIZONTE-MG, CEP 30450-250, BRASIL	TEL: (55) 31-3297-6166 FAX: —
MAYEKAWA DO BRASIL LTDA. (CHAPECO BRANCH)	RUA FERNANDO MECHADO, 593 D-S 201 CHAPECO-SC CAIXA POSTAL 177, CEP 89801-973, BRASIL	TEL: (55) 49-3322-4241 FAX: (55) 49-3322-4241
MAYEKAWA DO BRASIL LTDA. (CUIABA BRANCH)	AVENIDA ISSAC POVOAS, 586 – SALA 405 EDIFICIO WALL STREET - CENTRO CUIABA-MT, CEP 78055-560, BRASIL	TEL: (55) 65-3023-7559 FAX: —
MAYEKAWA DO BRASIL LTDA. (CURITIBA BRANCH)	RUA ISABEL A. REDENTORA, 1826 – SALA 8 CENTRO - SAO JOSE DOS PINHAIS-PR, CEP 83095-980, BRASIL	TEL: (55) 41-3383-1518 FAX: —
MAYEKAWA DO BRASIL LTDA. (CAMPO GRANDE BRANCH)	RUA JOSE ANTONIO PEREIRA, 2200 – S 02 CONDOMINIO COSTA D'OURO CAMPO GRANDE-MS, CEP 79010-190, BRASIL	TEL: (55) 67-3042-7200 FAX: —
MAYEKAWA DO BRASIL LTDA. (GOIANIA BRANCH)	RUA C, 255 – QUADRA 588 – LOTE 4/8 SALA 1004 – CENTRO EMPRESARIAL SEBBA GOIANIA-GO, CEP 74280-010, BRASIL	TEL: (55) 62-3093-5062 FAX: —

Description	Location	Telephone and facsimile No.
MAYEKAWA DO BRASIL LTDA. (OESTE PAULISTA BRANCH)	AV. FRANCISCO DE CHAGAS OLIVEIRA, 344 JARDIM PINHEIRO SAO JOSE DO RIO PRETO-SP, CEP 15091-330, BRASIL	TEL: (55) 17-3227-0235 FAX: —
MAYEKAWA DO BRASIL LTDA. (RECIFE BRANCH)	RUA SA E SOUZA, 687 – SALA 103 SETUBAL RECIFE-PE, CEP 51030-065, BRASIL	TEL: (55) 81-3342-7670 FAX: -
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1 Safety

1.1 Observation/Prevention

1.1.1 Observance (Do's)

1.1.1.1 Do's on Operation

- Attach safety and protection devices into compressors operation sequence.
- Regularly inspect the safety and protective devices function properly.
- If safety and protective devices do not work properly or the machine continues to run even during test of these devices, stop the operation! Inform your supervisor of it immediately.
- If the compressor stops for unknown reasons, immediately inform your supervisor of it. Obtain his/her approval before restarting the compressor.
- Some refrigerants in use generate bad smell or toxic gases, or may cause deficiency of oxygen. Make sure to ventilate the air during operation.
- The properties of refrigerant and refrigerant oil can be corrosive, decomposable, and/or toxic, insure to obtain the Material Safety Data Sheet (MSDS) and follow its instructions.
- When stopping the operation of this compressor, turn "OFF" the motor (main power), heater power, and control power. Close the suction and discharge side shut-off valves. Follow proper compressor evacuation procedures.

1.1.1.2 Do's on Maintenance

- Before performing the work together with at least one other person, thoroughly confirm the work details and acknowledge other worker's movement.
- Always turn OFF and lock out/tag out the motor (main power), control power, and other devices before troubleshooting during operation, and before setup, cleaning, or maintenance and inspection of the compressor.
- Always lock out/tag out the fluid supply/stop valve and the valves at downstream or upstream side of an opening part before troubleshooting during operation, setup, cleaning, or maintenance and inspection of the compressor to prevent the valves from opening during work.
- Some refrigerants in use generate bad smell or toxic gases, or may cause deficiency of oxygen. Make sure to ventilate the air during work.
- The properties of refrigerant and refrigerant oil can be corrosiveness, decomposability, and/or toxicity, insure to obtain the Material Safety Data Sheet (MSDS) and follow its instructions.
- After using tools always restore to designated place and never leave tools in the compressor.

1.1.1.3 Do's on Lockout/Tagout after Shutting off the Power

- Prepare lockout/tagout devices for the main breakers of motor main power and control power. Performing lockout/tagout after shutting off the power is very effective for preventing mis-operation of the worker, and for preventing injury of all workers that are working in the power facility and on the compressor.
- If there are any possibilities of danger during works (especially during cleaning, maintenance and inspection, and troubleshooting), turn "OFF" the motor main power and control power, and perform lockout/tagout.
- The worker himself must always lock out/tag out the compressor before working in the compressor for troubleshooting during operation, setup, cleaning, or maintenance and inspection of the compressor.
- The worker who performed lockout/tagout should release them after checking that all procedures have completed.

1.1.1.4 Do's about Personal Protective Devices

- Prepare and use protective devices complying with the safety standards of the regulations.
- Check the function of each protective device before using.
- Wear designated clothes such as work outfits.
- Do not wear any neckties or jewelry as there is a possibility of being entangled by a movable part or rotating part. Put on a helmet as your hair may get entangled.
- Do not have anything in your pocket to prevent objects from falling into the machine.

1.1.1.5 Do's about Handling of Hazardous and Toxic Substances

- Obtain Material Safety Data Sheet (MSDS) from manufacturers of hazardous and toxic substances.
- Check the MSDS and follow the handling instructions recommended by the manufacturers to handle and store those substances.

【POINT】

- An example of Material Safety Data Sheet (MSDS) is provided as a reference at the end of this chapter.

1.1.1.6 Do's about Handling Emergency Situation

- Formulate an emergency action plan complying with the regulations, and post it on a safe place.

1.1.1.7 Do's about Waste Oil, Fluid, and Materials

- Disposing of refrigerant and oil used for the compressor are subject to a number of regulations for the environmental protection purposes. Follow the local, state, federal acts and regulations and your company's rules when disposing of such waste oil, fluid and materials.

1.1.1.8 Other Do's

- Keep the floor clean around the refrigerating, cold storage, and air conditioning systems, and keep passages and walkways clear.
- Walk only on the areas set up as a work floor. Also, do not leave tools and cleaning solutions in that area.
- If water or oil is spilled on the compressor or the floor, immediately wipe it off to prevent workers from injury caused by slipping.

1.1.2 Don'ts

- Do not remove or relocate any safety device, including electrical interfaces.
- Do not disable any safety device by short-circuiting or bypassing without any permission.
- Do not leave the compressor unsafe and unattended, by removing a safety cover or some other measures.
- Do not touch, clean, or lubricate any moving part of the compressor during operation.
- Do not touch, clean, or lubricate the compressor during its operation.
- Do not touch relays or electric systems such as terminal block with bare hands when turning on the power.

1.2 Warnings

To alert workers to possible danger, the following two measures are always provided with the compressor.

- Warnings described in this manual
- Safety labels affixed on the compressor

1.2.1 Types and Meanings of Warnings

This manual includes the following four types of warnings to be used for expected hazards during operation and maintenance of the compressor.

Neglecting such warnings may cause accidents, resulting in personal injury or even death.

Also, the compressor or its auxiliary equipment may be heavily damaged. Therefore, be sure to always observe the instructions of the warnings.

DANGER	Indicates an imminently hazardous situation which, if not avoided, will result in serous injury or death.
WARNING	Indicates a potential hazardous situation which, if not avoided, could result in serous injury or death.
CAUTION	Indicates a potential hazardous situation which, if not avoided, may result in minor or moderate injury.
CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in property damage.
【POINT】	Emphasizes important items and indicates profitable information.

1.2.2 Safety labels

The following shows the types of the safety labels and their positions affixed on the compressor. Always follow the warnings instructed on the safety label affixed on the compressor.

⚠WARNING

- **Be sure to follow the instructions of the safety labels. Otherwise, danger resulting in personal injury, death, or property damage may arise.**
- **Do not smear, cover, or peel off the safety labels.**
- **If the safety labels are damaged or missing, purchase and affix new labels to their proper positions according to this manual.**

【POINT】

- Inform our service center of the product name and safety label No when placing a purchase order for safety labels.

■ Types of Safety Labels

Table 1-1 Safety label

No.	Safety labels	Remarks
1		For specification with belt cover
2		

■ Affixing Positions of Safety Labels

The figure below shows the affixing positions of safety labels.
The numbers in the figure correspond to the ones in Table 1-1 Safety label.

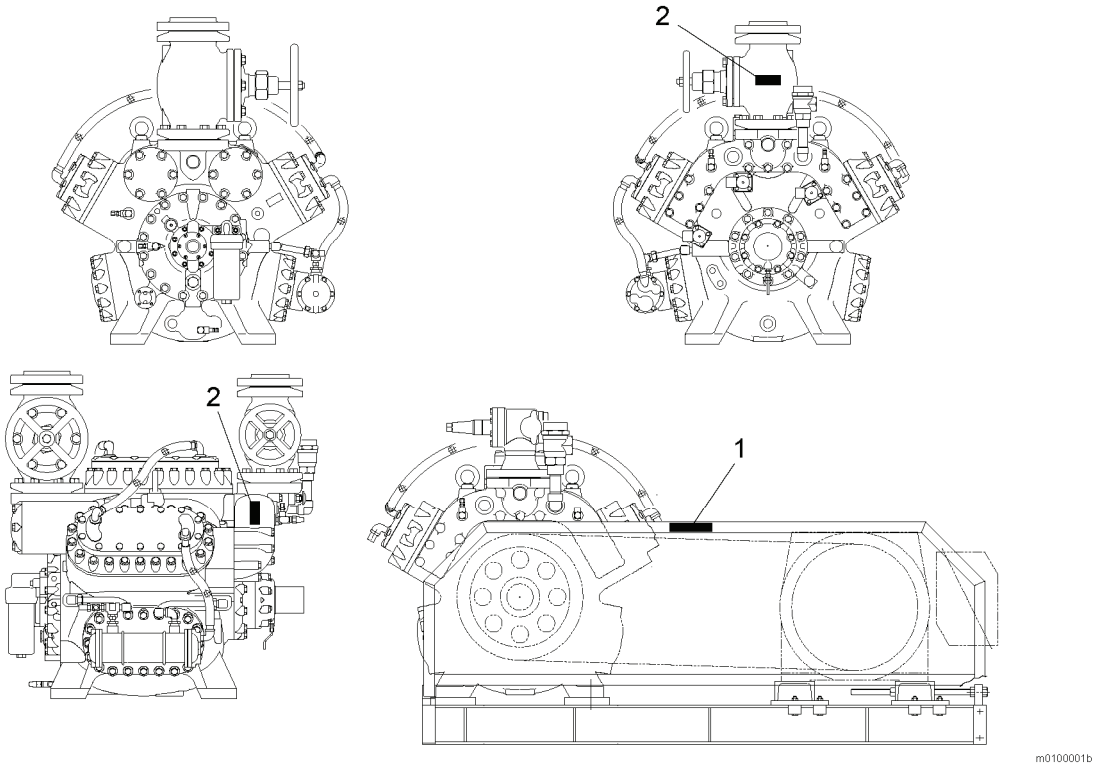


Fig. 1-1 Affixing positions of safety labels (Ex: 6M)

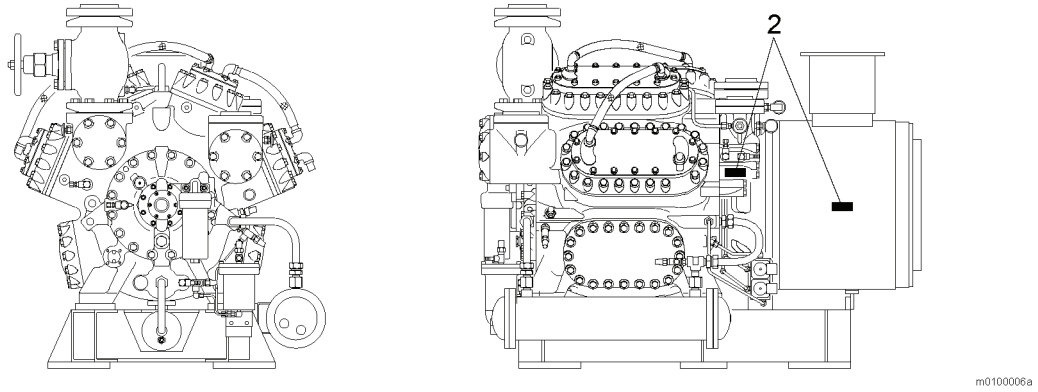


Fig. 1-2 Affixing positions of safety labels (Ex: 62M-FM)

1.3 Remaining Hazard

The following information is provided on the assumption that this compressor is operated, inspected, and maintained while being used in general refrigerating, cold storage, and air conditioning systems. Note that all hazardous sources cannot be predicted for the refrigerating, cold storage, and air conditioning systems you actually use.

Devise appropriate countermeasures for hazardous sources in your systems.

Table 1-2 Hazardous sources

	Hazardous parts	Predicted hazard	Counter measures in operation	Counter measures in cleaning, inspection, and parts exchange
A	Driving section	• Contact and entanglement in rotational part • Drop-off of moving part • Recovery after interruption of energy supply	• Installation of guard and cover	• Lockout/tagout of motor main power and control power
B	Head cover	• Damage caused by contacting hot part	• Installation of guard • Wearing protective devices	• Wearing protective devices • Operation with a temperature of 40°C or less
C	Discharge piping	• Damage caused by contacting hot part	• Installation of guard • Wearing protective devices	• Wearing protective devices • Operation with a temperature of 40°C or less
D	Unloader solenoid valve	• Electric Shock	• Installation of guard • Wearing protective devices	• Lockout/tagout of control power
E	Heater	• Electric Shock • Burns	• Installation of guard and cover • Wearing protective devices	• Lockout/tagout of the heater power • Wearing protective devices • Operation with a temperature of 40°C or less
F	Suction (side) shut-off valve	• Contact with and inhale of toxic substances • Low temperature burns	• Wearing protective devices • Sufficient ventilation • Installation of guard	• Wearing protective devices • Sufficient ventilation
G	Discharge (side) shut-off valve	• Contact with and inhale of toxic substances • Burns	• Wearing protective devices • Sufficient ventilation • Installation of guard	• Wearing protective devices • Sufficient ventilation • Operation with a temperature of 40°C or less
H	Gas purge valve	• Contact with and inhale of toxic substances	• Wearing protective devices • Sufficient ventilation	• Wearing protective devices • Sufficient ventilation
I	Oil drain	• Burns • Contact with toxic substances	• Do not contact with it during operation	• Wearing protective devices • Operation with a temperature of 40°C or less
J	Noise and vibration	• Damage caused by noise	• Wearing protective devices	—
K	Motor	• Damage caused by high temperature • Electric Shock	• Wearing protective devices	• Lockout/tagout of motor main power and control power • Wearing protective devices • Operation with a temperature of 40°C or less

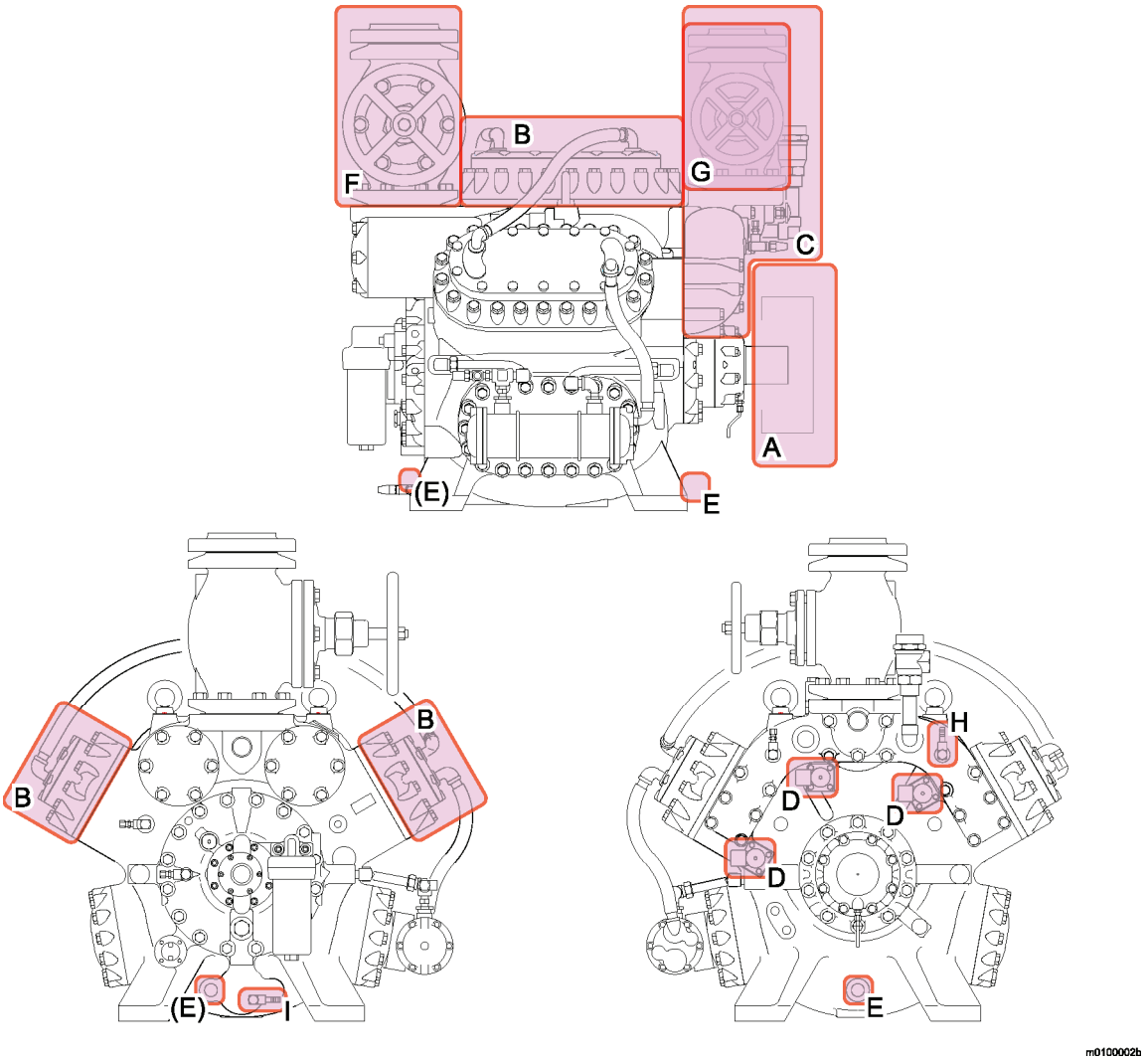


Fig. 1-3 Hazardous sources (Ex: 6M)

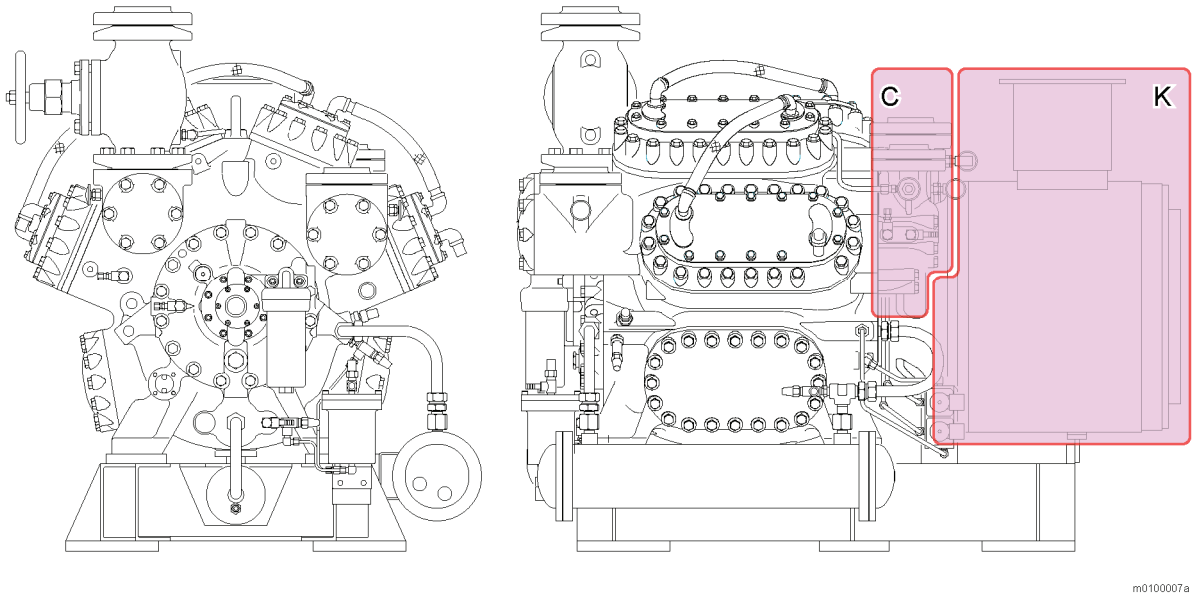


Fig. 1-4 Hazardous sources (Ex: 62M-FM)

1.4 Safety Devices

For safe use and protection of the compressor, make sure to attach safety devices to your compressor, complying with the regulations and the following instructions for each devices.

Periodically perform inspection and maintenance of devices for normal/proper operation. Maintenance and inspection must be performed as an important part for the safety of machine and personnel. Provide users of the compressor with necessary information on the safety devices, for example, types of the safety devices, installation position, function, and inspection method of safety related devices.

WARNING

- **Check the safety devices after turning on the power and before operation of the compressor. If they do not operate normally, immediately take repair or replace safeties before starting compressor.**

1.4.1 Emergency Stop Button

■ Overview/Function/Purpose

Used to stop the compressor immediately if an emergency occurs in the compressor.

■ Installation Positions

On the control board on the compressor and in the operation control room

■ Stop/Restoration Methods

Specify the stop/restoration methods of emergency stop button, and make sure to provide users of this compressor with them.

■ Inspection Method/Cycle

The emergency stop button requires test to ensure compressor is shut down when pressed, insure this is done before testing the operation of compressor and periodically after compressor is put into service. Specify the inspection methods/cycle of the emergency stop button, and make sure to provide users of this compressor with them.

1.4.2 Breakers of Motor Main Power and Control Power (with Lockout/Tagout Devices)

■ Overview/Function/Purpose

When working on compressor (especially during cleaning, maintenance, inspection, and troubleshooting), ensure to lockout/tagout main and control power to prevent mis-operation and hazards to workers while the motor main power and control power are turned "OFF".

■ Methods of Performing and Releasing Lockout/Tagout

Make sure to clearly notify methods of performing and releasing lockout/tagout referring to the regulations created by Occupational Safety & Health Administration (OSHA) or local governing body.

1.4.3 Safety Belt/coupling Guard

■ Overview/Function/Purpose

Prevents contact and entanglement in the driving section of this compressor.

■ Installation Positions

Driving section

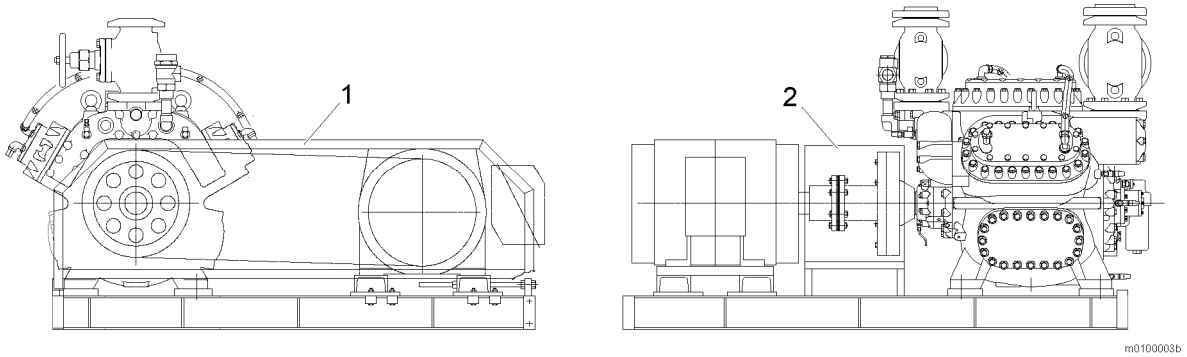


Fig. 1-5 Attachment of driving section safety cover (6M)

No.	Description
1	Driving section safety cover (for belt)

No.	Description
2	Driving section safety cover (for coupling)

■ Inspection Method/Cycle

Specify the inspection methods/cycle of the safety cover, and make sure to provide users of this compressor with them.

1.4.4 Safety valve

■ Overview/Function/Purpose

A safety valve is used to prevent the compressor from bursting when its internal pressure rises abnormally.

■ Installation Positions

Install a safety valve on discharge outlet between the shut-off valve (service valve) and the compressor. Set the safety valve so that it operates even when the shut-off valve is closed during operation.

⚠ WARNING

- **Properly terminate the discharge outlet of safety valve according to the type of refrigerant, following the local, state, federal acts and regulations. If ammonia is discharged into the atmosphere, it highly possibly causes health damage such as intoxication and bad smell. And if it is discharged into enclosed space such as inside of the compressor, it may cause serious accident such as deficiency of oxygen.**

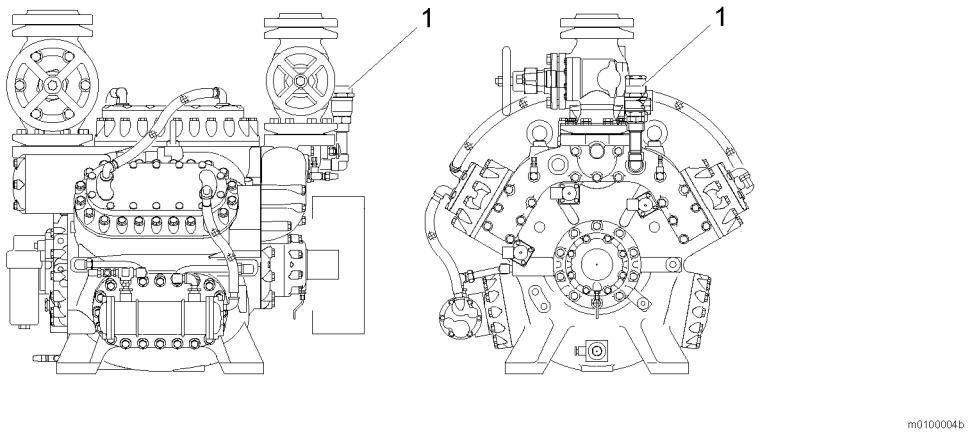


Fig. 1-6 Attachment example of safety valve

No.	Description
1	Safety valve

■ Settings

Set the pressure of safety valve to the designed system pressure or lower. Specify the safety valve settings, and make sure to provide users of this compressor with them.

■ Inspection Method/Cycle

Insure to replace or repair safety relief valve following the local, state, federal acts and regulations.

1.4.5 Automatic Control and Protection Equipment M compressor

■ Overview/Function/Purpose

- Low oil pressure failure protection equipment (OP)

  When the oil pressure in compressor (Gauge pressure minus crank case pressure) drops from deficiency of refrigerant oil, clogging of filter, and interfusion of refrigerant, automatically shuts off the motor circuit and stops the operation of compressor.

  This intended to prevent damage to the compressor from abnormal friction. Can also cause the unloader mechanism from malfunctioning

- High pressure protection equipment (HP)

  When the discharge pressure on compressor becomes abnormally high because the compressor is operated incorrectly or the water supply for condenser is cut. HP switch shuts off the motor circuit automatically to stop the operation of compressor.

  Prevents system ruptures and refrigerant leaks.

- Control of the compressor capacity: Low pressure control equipment (LP)

  The number of capacity control step in the compressor is determined by the number of cylinder.

  Generally two cylinders are considered as one bank. Therefore, capacity control of four steps is available for eight cylinders, three steps for six cylinders, and two steps for four cylinders. Capacity control is performed by detecting suction pressure the low pressure control switch is used.

  It automatically controls opening/closing of the solenoid valve connected to the unloader piston in the capacity control mechanism of compressor.

■ Connecting Positions

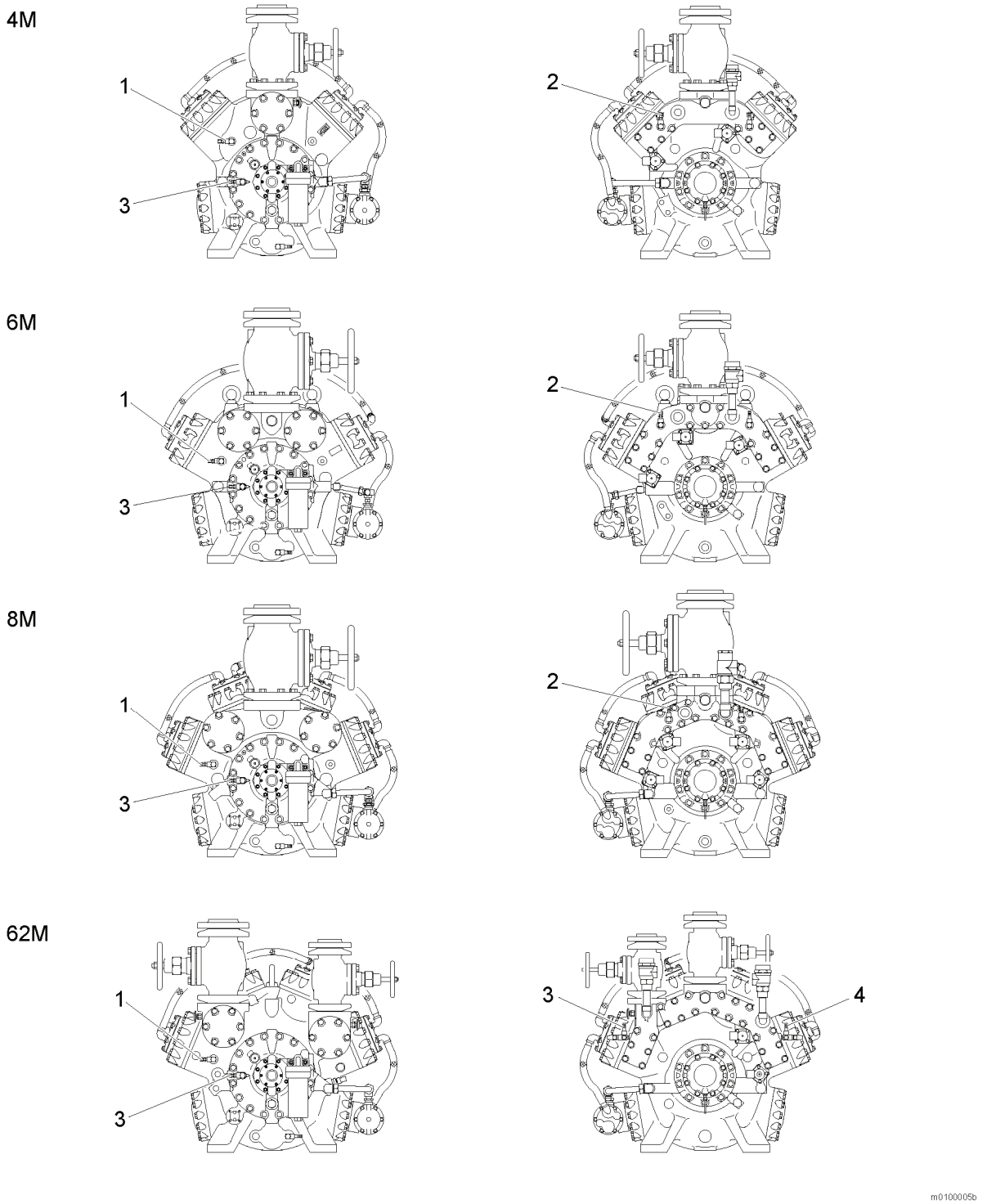


Fig. 1-7 Connections of low oil pressure failure protection equipment (OP)/
high pressure protection equipment (HP)/low pressure control equipment (LP)

No.	Description
1	Low pressure gauge connection φ 6 (LP/OP)
2	High pressure gauge connection φ6 (HP)

No.	Description
3	Oil pressure gauge connection φ 6 (OP)
4	Intermediate pressure gauge connection φ 6 (OP)

■ Settings

Specify the settings of Low oil pressure failure protection equipment (OP), High pressure protection equipment (HP), and Low pressure control equipment (LP) referring to the table below, and make sure to provide the users of this compressor with the information.

Table 1-3 Settings (example)

	Compressor failure	Compressor enabled	Timer	Recovery
Low oil pressure failure protection (OP)	Suction pressure +0.10 MPa	Suction pressure +0.12 MPa	30 seconds	Manual reset
High pressure protection (HP)	2.7 MPaG or lower*	—	None	Manual reset
Low pressure control (LP)	Depends on refrigerant and system in use			Automatic reset

【POINT】

- For high pressure protection (HP), set value lower than the safety relief valve. Set the value to protection equipment to detect an error immediately. Measure pressure electrically and generate an alarm by a control circuit, to generate a pre-alarm when the pressure is approaching the abnormal value.

■ Inspection Method/Cycle

Each compressor's protection equipment requires operational test and for function and accuracy. Specify the inspection methods/cycle of respective compressor protective equipment, and make sure to provide users of this compressor with them.

⚠ WARNING

- **If operation test of high pressure protection equipment (HP) is performed at the setting value, it may cause explosion of devices. Make sure to perform the test at the normal operation pressure or below.**

CAUTION

- **For operational test, use devices such as pressurize tester to check that alarms and switches operate normally. Do not operate the compressor with all the valves closed, or in any other dangerous conditions.**

CAUTION

- **If low oil pressure failure protection (OP) or high pressure protection (HP) shutdown the system, make sure to eliminate the cause of it before resetting the compressor.**

1.4.6 Compressor Cooling Fluid Temperature Failure Alarm

■ Overview/Function/Purpose

Prevents the head cover and refrigerant oil from becoming too hot by stopping the compressor.

■ Installation Positions

Cooling Fluid system

■ Settings

Specify the settings of cooling fluid temperature failure alarm, and make sure to provide users of this compressor with them.

■ Inspection Method/Cycle

The Cooling Fluid failure alarm requires operational test before operating the compressor and periodically testing after that. Specify the inspection methods/cycle of cooling fluid temperature failure alarm, and make sure to provide users of this compressor with them.

1.4.7 Oil Heater and Thermometer Switch

CAUTION

- **Always insure the Oil heater and thermometer switch are completely immersed in oil before applying power. If power is applied to heater damage to the heater will occur, destroying the element from dry burn. Pay constant attention to the oil level while applying power to the heater.**

■ Overview/Function/Purpose

The oil heater is a cartridge type covered heater. It is pressure-proof sealed type with heating wires wrapped with insulator and externally sealed with stainless tube.

The oil heater is used to prevent refrigerant from dissolving in oil or condensing in the crank case during the off cycle of the compressor.

■ Installation Positions

The thermometer switch which controls temperature of heater is attached inside the heater.

■ Settings

Specify the thermometer switch settings, and make sure to provide users of this compressor with them.

■ Inspection Method/Cycle

The thermometer switch requires set up and testing before operating the compressor and periodically after that. Specify the inspection methods/cycle of the thermometer switch, and make sure to provide users of this compressor with them.

1.5 Example of Material Safety Data Sheet (MSDS)

Material Safety Data Sheet for Chemical Substances

NOTE: This material is an extract from the guidance regarding the indication on hazardousness/harmfulness of chemical substances for occupational safety and health (general rules).

Prepared by (or name of corporation)

Address
Department/Section in charge : Staff in charge :
Phone number :
Fax number :
Phone No. in emergency :

Prepared/revised: (Date)

Name of chemical substance

Specification of substance
- Distinction of single substance or mixture
- Chemical name
- Component and content
- Chemical formula or structural formula
- Official gazette notice file No. (OSHA, Chemical Examination Law)
- CAS No.
- U.N. classification & U.N. No.

Type of hazardousness/harmfulness

Emergency measure
- When entered eyes
- When stuck on the skin
- When inhaled
- When swallowed

Measures at a fire
- Fire extinguishing method
- Fire extinguishing agent

Measures at leakage

Precautions for handling and storage
- Handling
- Storage

Exposure preventive measures
- Controlled density
- Allowable density
  - Japan Industrial Hygiene Institute (Edition)
  - ACGIH (Edition)
  - Other exposure limit value, reference value
- Measures for facility
- Protective equipment
  - Breathing protective equipment
  - Goggles
  - Protective gloves
  - Protective clothing

Physico-chemical property

Appearance						
Boiling point	°C	Steam pressure	Pa	(	°C)	Volatile
Melting point	°C	Specific gravity or bulk specific gravity		(	°C)	
Solubility Water			%	(	°C)	
Other solvent	( )		%	(	°C)	
Others						

Hazardousness information (Stability, reactivity)

Flash point	:	°C	Fire point	:	°C
Explosion limit Upper limit	:	%	Lower limit	:	%
Inflammability	:				
Flammability	: (Autogenous ignition, reactivity for water)				
Oxidization	:				
Self-reactivity/explosiveness	:				
Dust explosiveness	:				
Stability/Reactivity	:				
Others	:				

Harmfulness information (including a human case, epidemiological information)

Corrosiveness	:
Stimulativeness (Skin, eyes)	:
Sensitization	:
Acute toxicity (incl. 50% lethal dose)	:
Subacute toxicity	:
Chronic toxicity	:
Cancer source property	:
Variation source property (Micro-organism, chromosomal aberration)	:
Reproductive toxicity	:
Teratogenicity	:
Others (incl. toxic gas generation when reacted on water)	:

Environmental impact information

Precautions for scrapping

Precautions for transportation

Applicable laws

Others
(1) If description space is not enough, attach detailed information.
(2) Reference for inquiry on the contents of description, quoted references, etc.

2 Configuration and Specification of Compressor

2.1 Configuration of Compressor

2.1.1 Overall View of Compressor

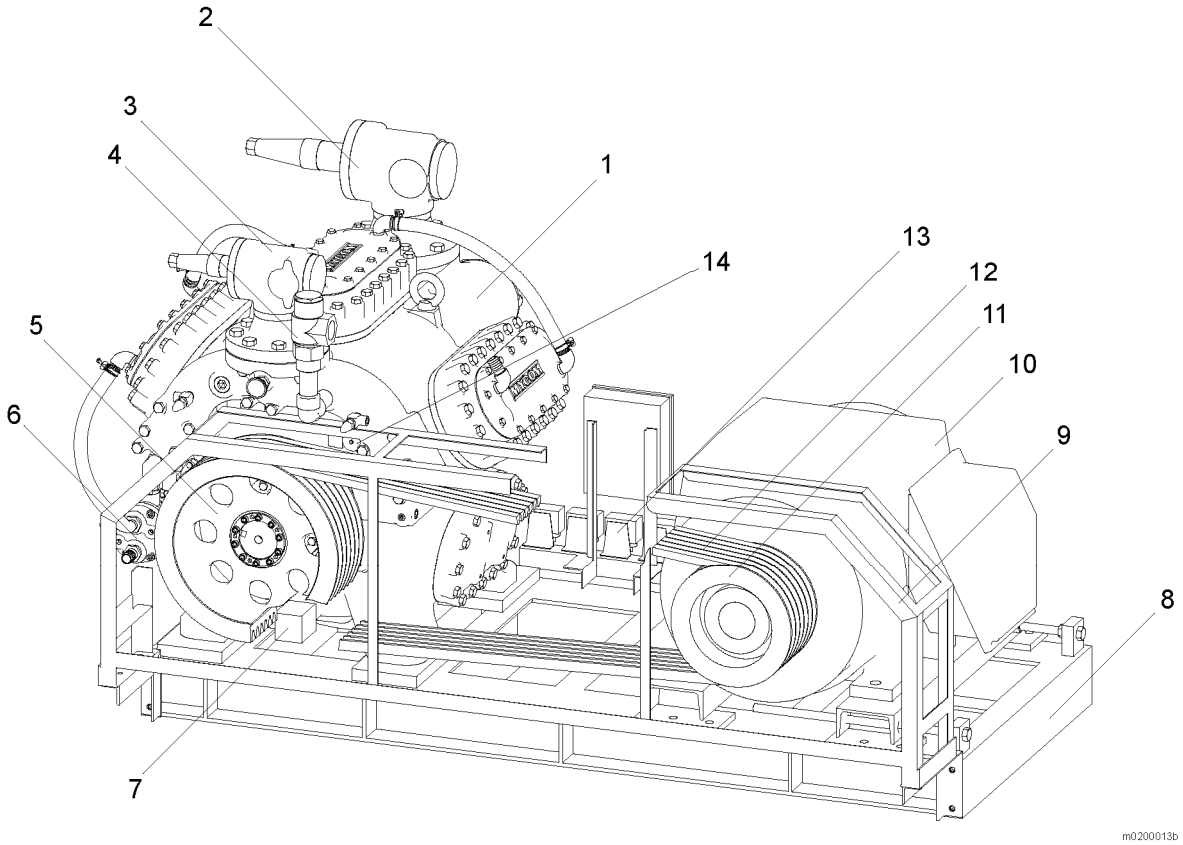


Fig. 2-1 Overall view (Ex: 6M)

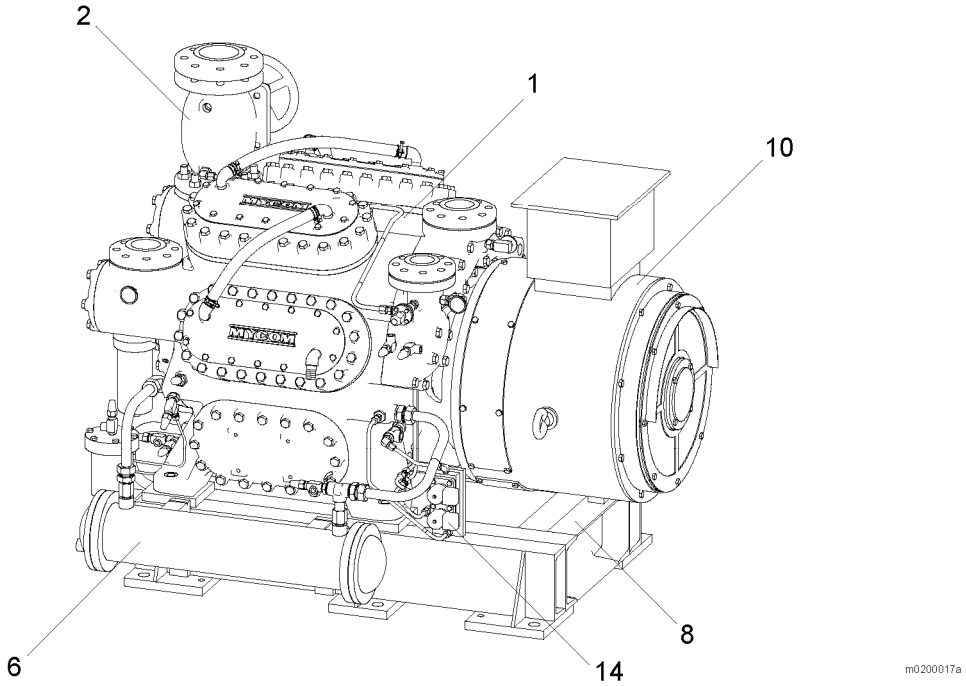


Fig. 2-2 Overall view (Ex: 62M-FM)

No.	Description
1	Compressor
2	Suction shut-off valve (Optional)
3	Discharge shut-off valve (Optional)
4	Safety valve (Optional)
5	Flywheel (Optional)
6	Oil cooler (Optional)
7	Oil heater (Optional)

No.	Description
8	Base (Optional)
9	Belt cover (Optional)
10	Motor (Optional)
11	Motor pulley (Optional)
12	V-belt (Optional)
13	Control switch (Control console) (Optional)
14	Unloader solenoid valve

【POINT】

- For names of each part, refer to "7.1 Development View and Configuration Table of the Parts".

2.1.2 Cross-Sectional View of Assembly

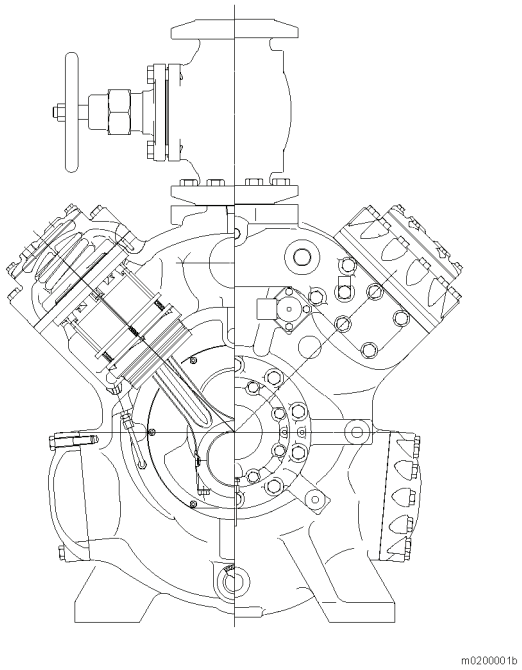


Fig. 2-3 Front view (4M)

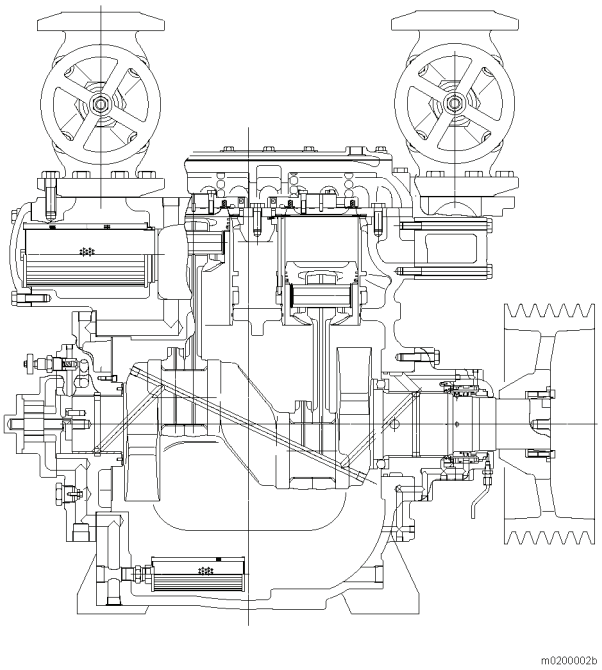


Fig. 2-4 Side view (4M)

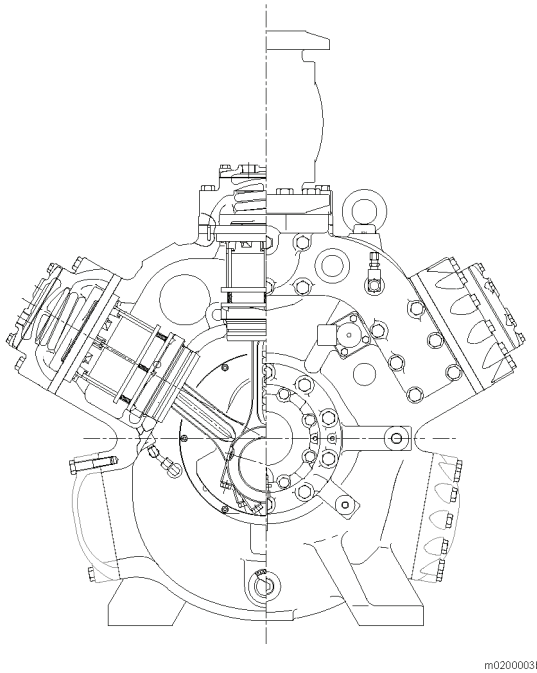


Fig. 2-5 Front view (6M)

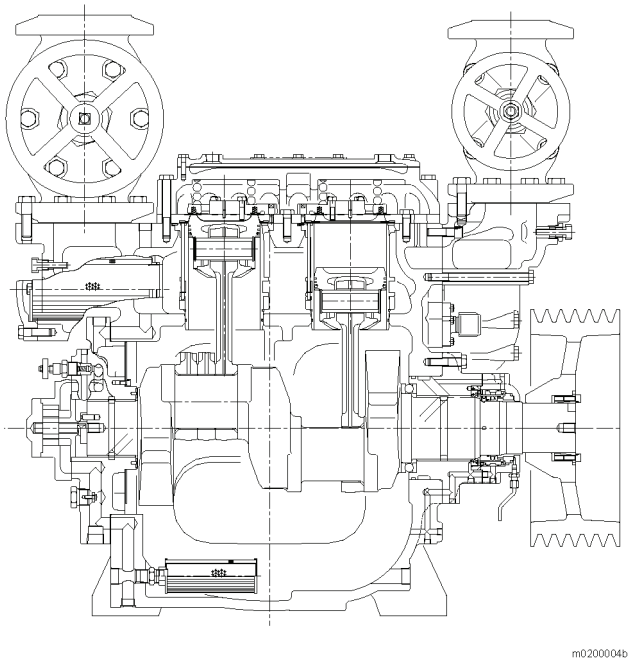


Fig. 2-6 Side view (6M)

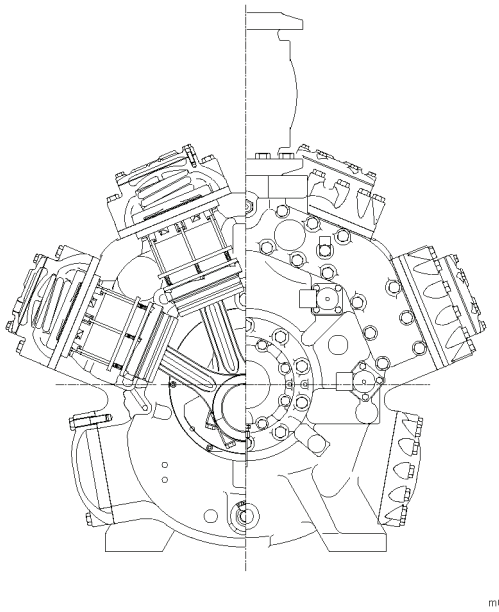


Fig. 2-7 Front view (8M)

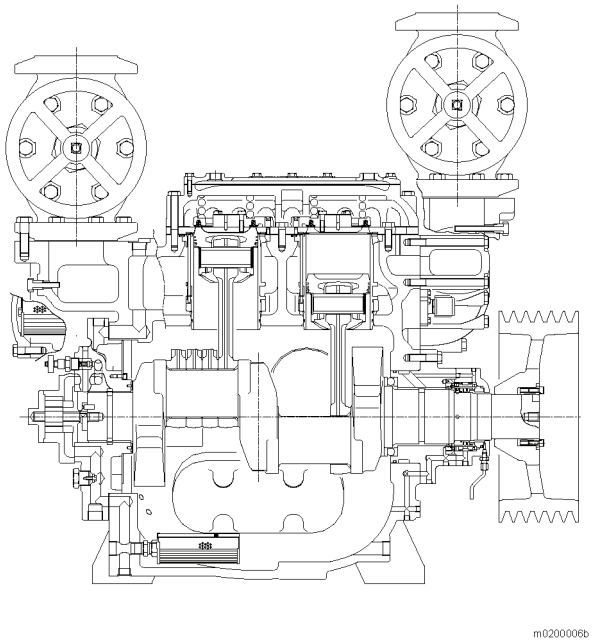


Fig. 2-8 Side view (8M)

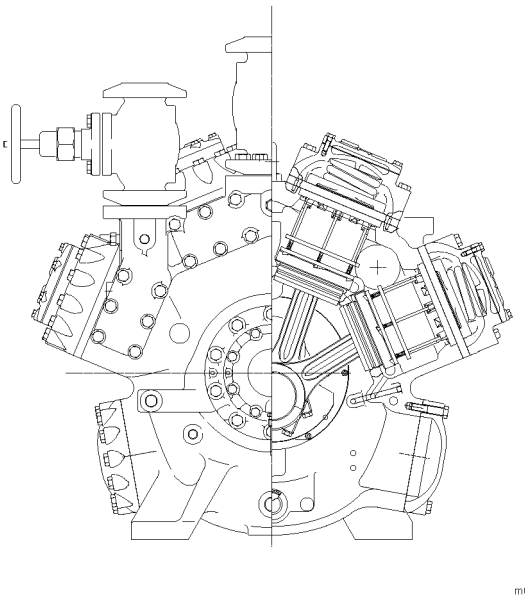


Fig. 2-9 Front view (62M)

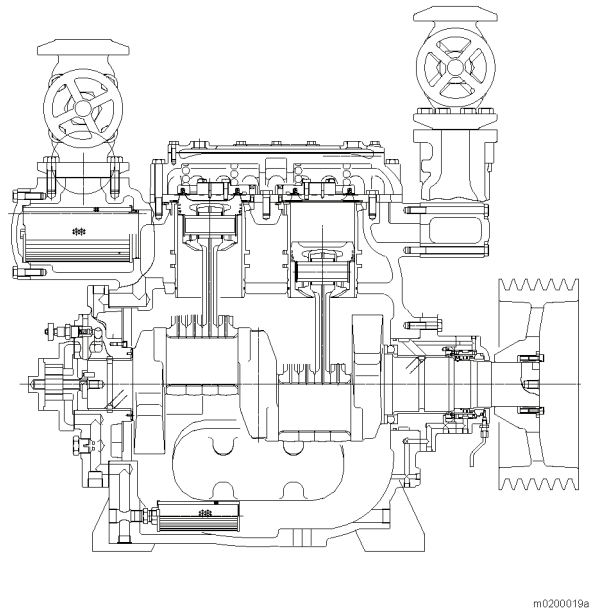


Fig. 2-10 Side view (62M)

2.1.3 Oil Supply Mechanism

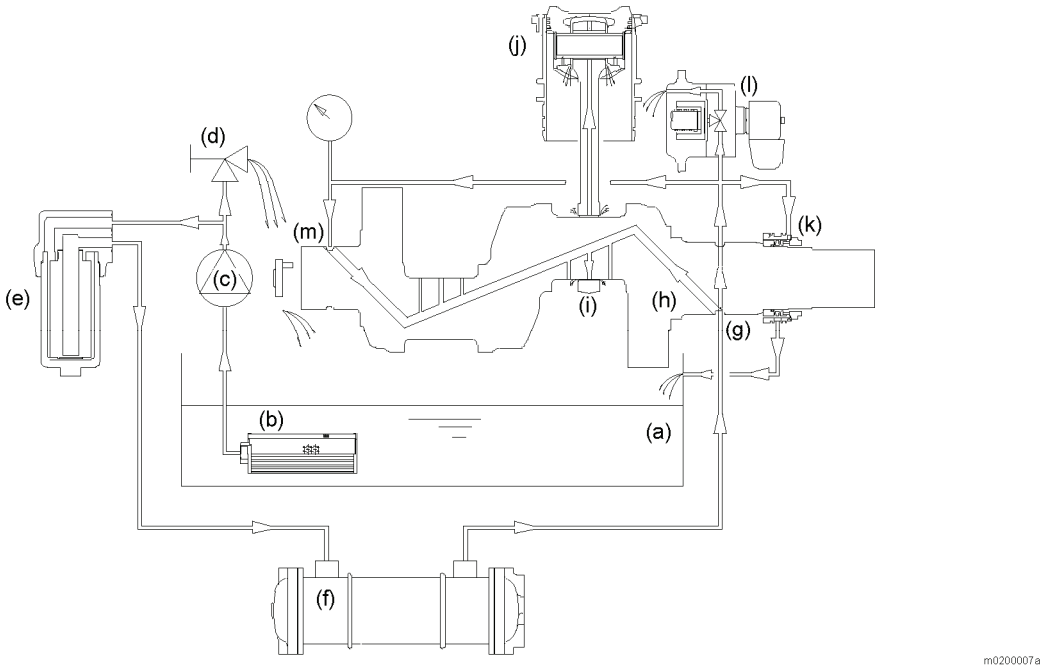


Fig. 2-11 Oil supply mechanism

1. Refrigerant oil is retained as required in the oil tank (a) at the bottom of crankcase.

2. When the oil pump (c) is driven by the crankshaft, refrigerant oil in the oil tank (a) is suctioned via the oil strainer (b).

3. The refrigerant oil is pressurized by the oil pump (c), and pumped into the oil pressure regulating valve (d) and oil filter (c).
The oil pressure regulating valve (d) bypasses part of refrigerant oil via the oil tank so that the difference between pressure in the oil tank (suction pressure) and oil supply pressure is maintained at a constant value.

4. The refrigerant oil filtered by the oil filter (e) is discharged from the crankcase to outside of the machine and passes the oil cooler (f).

5. The refrigerant oil cooled by the oil cooler (f) enters the crankcase. Then, it passes through the main bushing on seal side (g) and enters the oil supply opening on the crankshaft (h).

6. The refrigerant oil which passes the crankshaft (h) lubricates the crank pin (i), and passes the oil supply line in the con rod. Then it lubricates and cools the cylinder (j) (inner wall of the cylinder, piston ring, piston pin and bearing on the connecting rod small end).

7. The refrigerant oil which passes through the main bushing on seal side (g) passes the shaft seal (k), capacity control mechanism (unloader) (l), and the oil supply line in the case. Then, it is divided to be supplied to the main bushing on pump side (m).

1) The refrigerant oil which lubricates the shaft seal (k) returns to the oil tank.

2) The refrigerant oil which lubricates the main bushing on pump side (m) enters the oil supply opening on the crankshaft (h), then lubricates and cools the crank pin (i) and other parts.

3) The refrigerant oil which is supplied to the capacity control mechanism (unloader) (l) passes the oil supply groove on bearing head and oil supply opening on crankcase. Then it is supplied to each solenoid valve unloader cover integrated.

- When the solenoid valve is energized (ON), refrigerant oil enters the unloader cylinder and presses the unloader piston, and then the unloader mechanism becomes loaded. At this time, the oil flow stops. However, the unloader piston retains the position by being pressurized continuously.

- When the solenoid valve is not energized (OFF), oil supply from the pump is stopped. At the same time, the oil discharge route opens and the oil in the unloader cylinder is discharged. Then, the pressure decreases. The pressure which presses the unloader piston decreases, and the piston is pressed back by the force of unloader device spring. Then, the piston becomes unload.

2.1.4 Unloader Mechanism

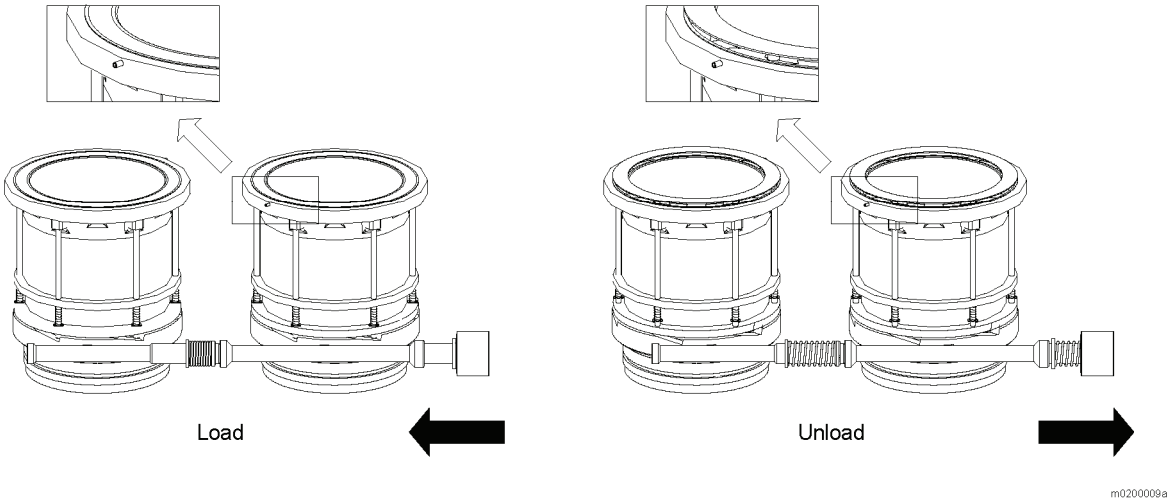


Fig. 2-12 Unloader mechanism

The capacity control (unloader) mechanism controls the operation of suction valve using unloader piston. By controlling the operation of suction valve, it changes the number of cylinder which compresses gas to change the suction capacity (performance).

The details of mechanism are as below.

- The suction valve (suction plate valve) are attached on the top of cylinder sleeve (flange). Gas enters into the cylinder from the passage between the external and internal seats. A lift pin which moves upward and downward is installed in the gas passage at the center of these seats. The top side of lift pin contacts the suction valve. The bottom of lift pin is on the inclined surface of cam ring on the cylinder which rotates on the diameter of cylinder sleeve. This cylinder cam ring is rotated by the rod which is moved by the unloader piston. This rotation moves the lift pin upward and downward.
- If the lift pin is moved downward to below the seats surface, the suction valve (suction plate valve) operates depending on the pressure difference. However, when the lift pin pushes up and retains the suction valve by the rotation of cam ring, the suction valve does not close even if pressure difference is generated. In this state, even though the piston moves upward and downward in the cylinder, the gas only passes in and out from the suction opening. Due to this, the pressure does not increase and the gas is not discharged. At this time, this cylinder is in unload state. As described above, this mechanism controls the capacity by changing the number of cylinder which compresses gas.
- The cam ring is moved by oil pressure and the spring. If the unloader piston is not pressurized by oil, it becomes unload by the force of spring. Therefore, the capacity can be controlled by cutting off the oil pressure during machine operation. This is performed by a three-way solenoid valve.

2.2 Specification of Compressor

2.2.1 Specification

Table 2-1 Specification of compressor body (not including suction/discharge valves)

Item	Unit	4M	6M	8M	62M
Refrigerant	–	NH_3			
Number of cylinder	–	4	6	8	Low stage: 6 High stage: 2
Cylinder diameter	mm	146			
Stroke	mm	106			
Designed pressure of high pressure section	MPaG	3.0[*1] (2.0)[*2]			
Designed pressure of low pressure section	MPaG	2.0			
Hydrostatic test pressure of high pressure side	MPaG	4.5[*1] (2.0)[*2]			
Hydrostatic test pressure of low pressure side	MPaG	3.0			
Pneumatic test pressure of high pressure side	MPaG	3.0[*1] (2.0)[*2]			
Pneumatic test pressure of low pressure side	MPaG	2.0			
Minimum rotation	rpm	800[*3]			
Maximum rotation	rpm	1500[*3]			
V-belt	–	4—6 Type: 8V (Optional)			
Displacement (at maximum rotation)	m^3/h	639	958	1278	Low stage: 958 High stage: 320
Capacity control range	%	100,50,(0)	100,66,33,(0)	100,75,50,25,(0)	100,66,33
Refrigerant Oil	–	Refer to "4.1 Refrigerant Oil".			
Oil filling amount	ℓ	32	38	44	44
Mass of the product	kg	1300	1580	1830	2000 (2700)[*4]
	Remarks	The above values include the weight of water cooling head cover, oil cooler, and flywheel.			

*1: Pressure values for cases and covers.

*2: Pressures for MAYEKAWA genuine shut-off valve.

*3: Rotation speed range will change depending on driving condition. Refer to the service range.

*4: For over hang motor specification (140 kW), see the value in parentheses.

Table 2-2 Specification of motor

Item	Unit	75kW	90kW	140kW
Rated output	kW	75	90	140
Voltage	V	220 or 440		440
Frequency	Hz	50 or 60		
Number of poles	–	6		
Type	–	Drip-proof case type (exclusive flange)		

2.2.2 Service Limits and Range

Table 2-3 Service limits for compressor

Item	Limit value for 4M, 6M, 8M	Limit value for 62M	Remarks
Maximum discharge pressure	2.6 MPaG (2.0 MPaG) *1	1.9 MPaG	
Maximum suction pressure	0.8 MPaG	0.14M PaG (0.5MPaG) *3	
Maximum differential pressure (top and bottom)	2.0 MPa		
Maximum oil supply pressure	Ps+0.4 MPaG		Ps = Suction pressure
Minimum oil supply pressure	Ps+0.1 MPaG		Ps = Suction pressure
Minimum evaporation temperature	–25°C (–60°C) *2	–60°C	
Maximum discharge temperature	160°C		
Maximum oil supply temperature	60°C		
Minimum oil supply temperature	30°C		
Maximum rotation	1500 rpm		Refer to service range for A, B ranges.
	1200 rpm	—	Refer to service range for C, D ranges.
Minimum rotation	800 rpm		Refer to service range for A, B ranges.
	900 rpm		Refer to service range for C, D ranges.
Cooling water outlet temperature	50°C or less		Allowable temperature of blade hose
Cooling Water	Clear water or brine		Do not use seawater
Degree of superheat: SH	20°C or less		Do not allow liquid back to occur.

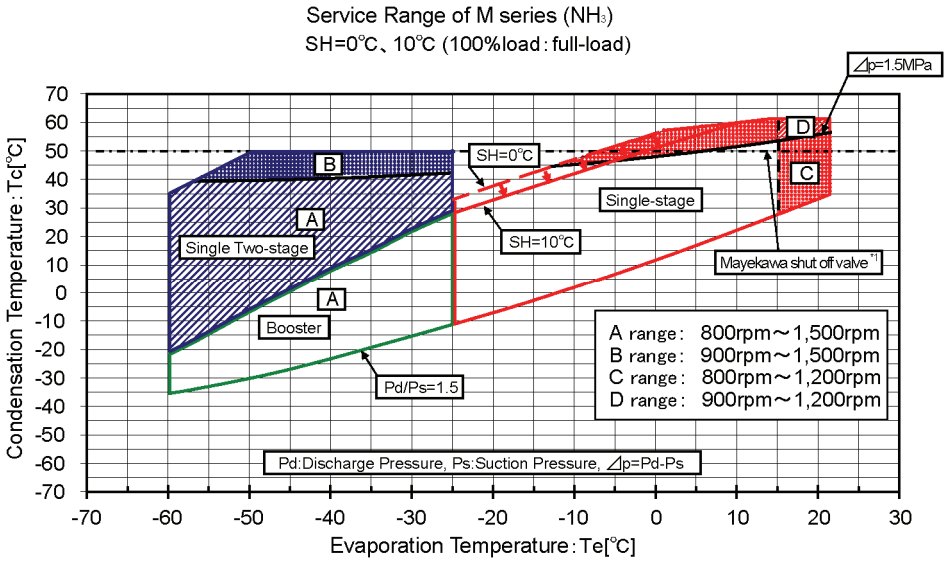
*1: For MAYEKAWA shut off valve specification, see the value in parentheses.

*2: For booster specification, see the value in parentheses.

*3: For single-stage/double-stage switching operation, see the value in parentheses.

【POINT】

- This product is designed to be used indoor or on land. Outdoor or shipboard application is possible by option. Contact us for outdoor or shipboard application.



*1: If the compressor is attached with MAYEKAWA shut off valve, maximum discharge pressure is 20 kg/cm^2. The condensed temperature upper limit is 50°C in that case.

Fig. 2-13 Service range of M series (NH_3)

Table 2-4 Service limits of motor

Item	Range	Remarks
Installation positions	Indoor	
Ambient temperature	0 to 45°C	
Ambient humidity	90% or below	
Altitude	1000 m or less	

2.2.3 External Dimensions

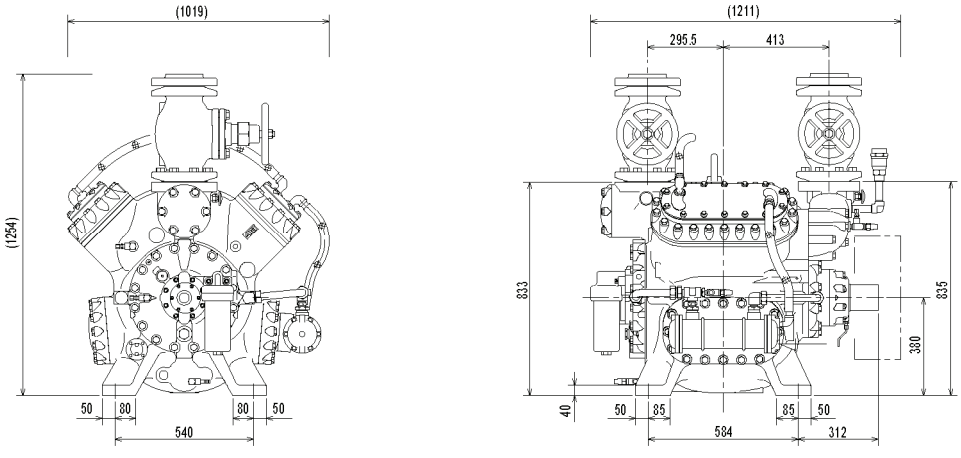


Fig. 2-14 External dimensions (4M)

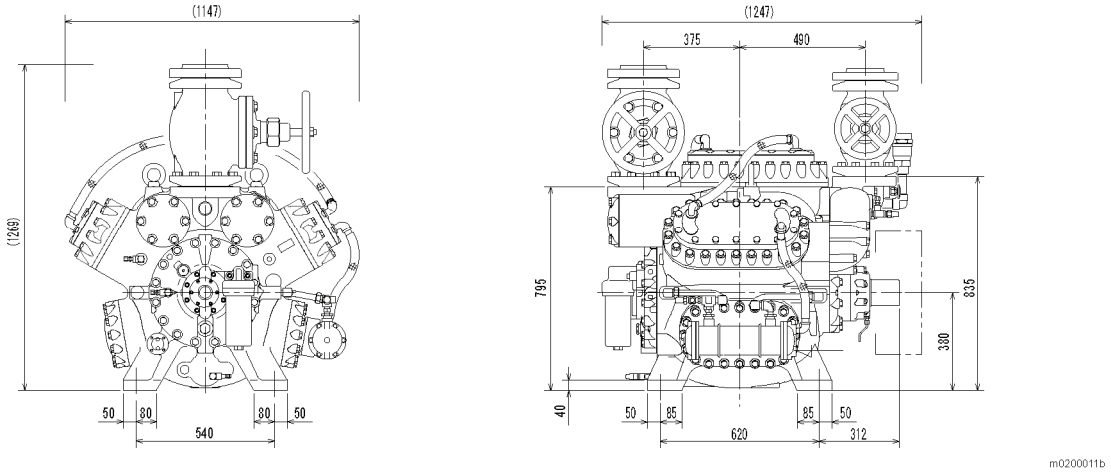


Fig. 2-15 External dimensions (6M)

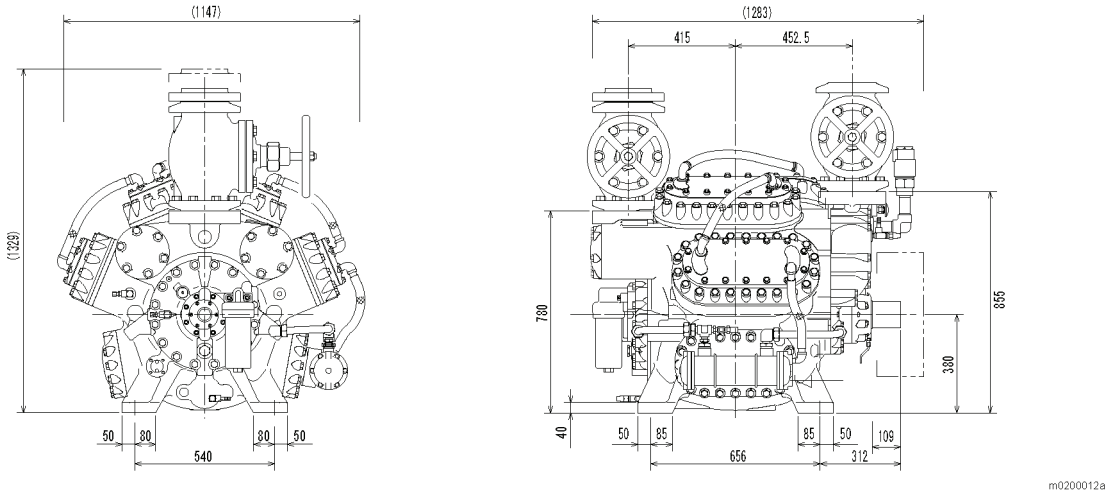


Fig. 2-16 External dimensions (8M)

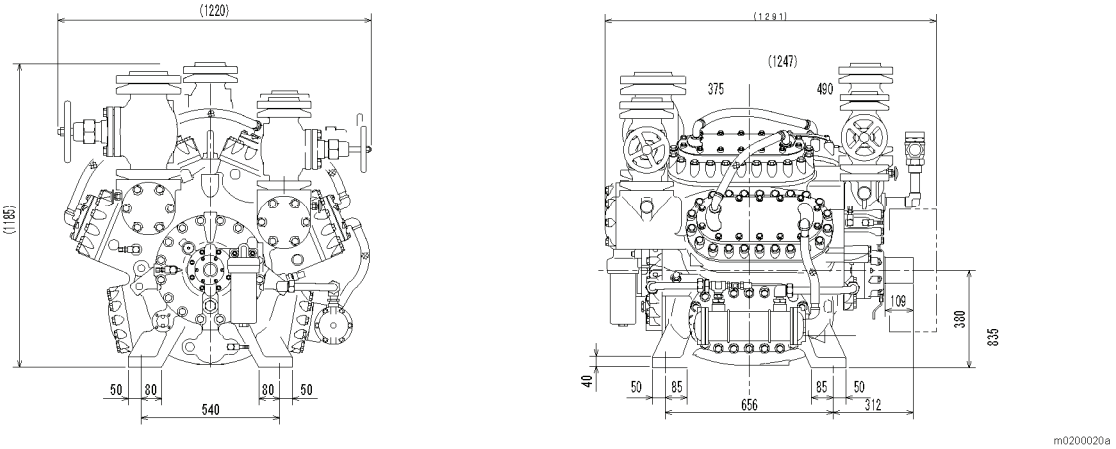


Fig. 2-17 External dimensions (62M)

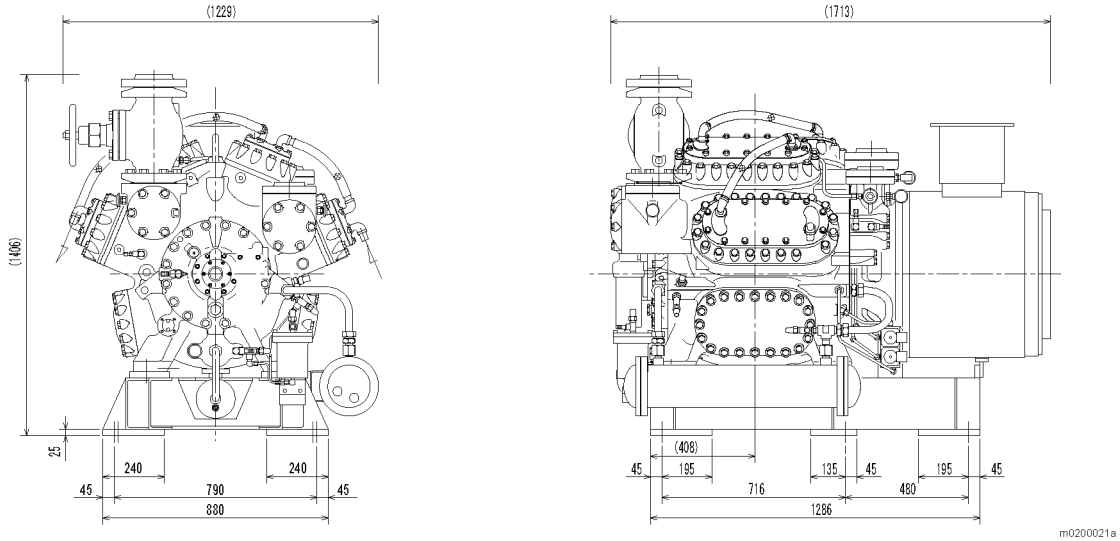
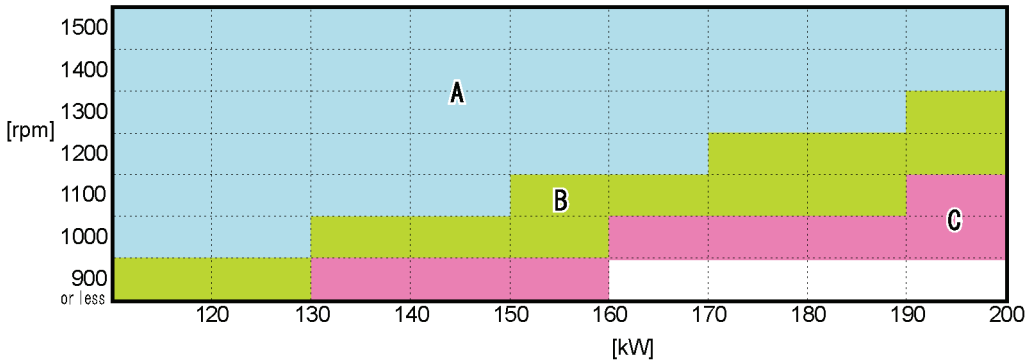


Fig. 2-18 External dimensions (62M-FM)

2.3 Selection of V-belt

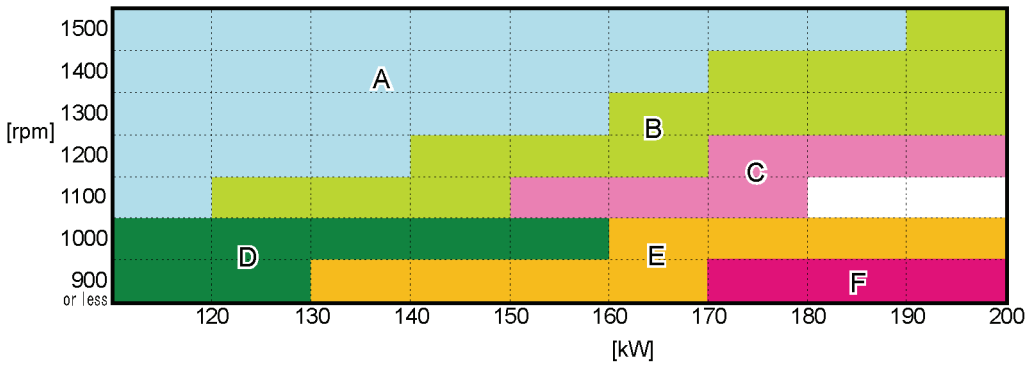
■ 50 Hz



(Motor : 4P x 50 Hz (1450 rpm), Center Distance : 1300 mm, Narrow Type belt/8V, P.C.D.(Flywheel) :475 mm)

m0200014b

■ 60 Hz



(Motor : 4P or 6P x 60 Hz (1200 or 1750 rpm), Center Distance : 1300 mm, Narrow Type Velt/8V, P.C.D.(Flywheel:475 mm)

m0200016b

Region	Number of V-belt	Motor
A	4	4P
B	5	
C	6	
D	4	6P
E	5	
F	6	

3 Installation

3.1 Safety Precautions for Installation

【POINT】

- This chapter is based on the assumption that the compressor is installed for the purpose of refrigeration, cold storage, and air conditioning systems, recreational systems.
  If the specifications differ with your systems, refer to this chapter and consider safety, before operation.
  If there are any questions, please contact your local sales offices or service centers.

- Insure that installation work is performed by a qualified personal or contracting company. Make sure that the work is performed in compliance with local laws and ordinances.
- Read this chapter and related documents, and fully understand their contents before performing installation.
- Electrical works should be performed only by electrical engineers.
- Do not place any part of your body under the lifted compressor.

3.2 Installation Works

3.2.1 Unpacking

Check that there is no abnormality such as damage on the compressor.

【POINT】

- If there are abnormalities or deficient parts on the compressor, please contact your local sales offices or service centers immediately.
- Unnecessary packing materials should be discarded according to the laws and ordinances, or your company's rules.

3.2.2 Storage

Perform the followings to store the compressor before installation.

- Store it indoors.
- Infuse nitrogen gas into the compressor and seal it.

【POINT】

- Nitrogen gas has been infused into the compressor at packing to prevent from rusting.

3.2.3 Transfer

⚠ DANGER

- **Dropping of the lifted compressor may cause death or serious injury. Do not stand under the lifted compressor.**

1. For lifting the compressor within the safety limit, use lifting equipment and tools appropriate for the weight of compressor.
2. Leave sufficient space for lifting.
3. Always check wire rope before using. Thoroughly check for kink, knot, or breakage. Do not perform lifting before checking the wire rope. If there are any problems, do not lift until equipment has been confirmed safe.
4. For lifting the compressor individually, hook the wire rope on the lifting bolt of compressor.
5. For lifting the compressor with base and motor, hook the wire rope on the lifting bolt and the base of compressor. Do not use the lifting bolt on the motor.
6. Check path of compressor installation to make sure it is free of obstacles.
7. Check that the hook is above the center of gravity of the unit before lifting.
8. Direct all the workers to stay clear of the work site before lifting.
9. Before lifting compressor notify all workers in area of dangers during lifting process. Remove all nonessential personal from area till lift is complete.
10. Wind up the wire rope slowly until shortly before the compressor leaves from the ground.
11. Remove all tension slowly until the compressor leaves the ground, and check that the compressor is balanced. If it is tilted, lower compressor and correct the tilt. Repeat this process until the compressor becomes level. Then wind up the wire rope.
12. Lift the compressor slowly. If it is lifted rapidly, it may damage the lifting tools such as wire rope or a part of the compressor.
13. When moving the lifted compressor, always use tag line/induction rope.
14. Do not lift the compressor over head unless absolutely necessary.
15. Do not lower the compressor and block the passage.

16. Remove obstructions before lowering the compressor onto the ground. The compressor should not be tilted or unstable.

17. Before lowering the compressor, notify others.

18. When lowering the compressor onto two or more blocks, align the tops of blocks so that the compressor becomes stable horizontally on them.

19. Lower the lifted compressor slowly so that it is not damaged by impact on the ground.

3.2.4 Preparation for Installation

■ Installation Space

The figures below show the minimum necessary space for disassemble and reassemble of the compressor. Referring to these figures, secure space which allows easy operation, cleaning, maintenance, and inspection.

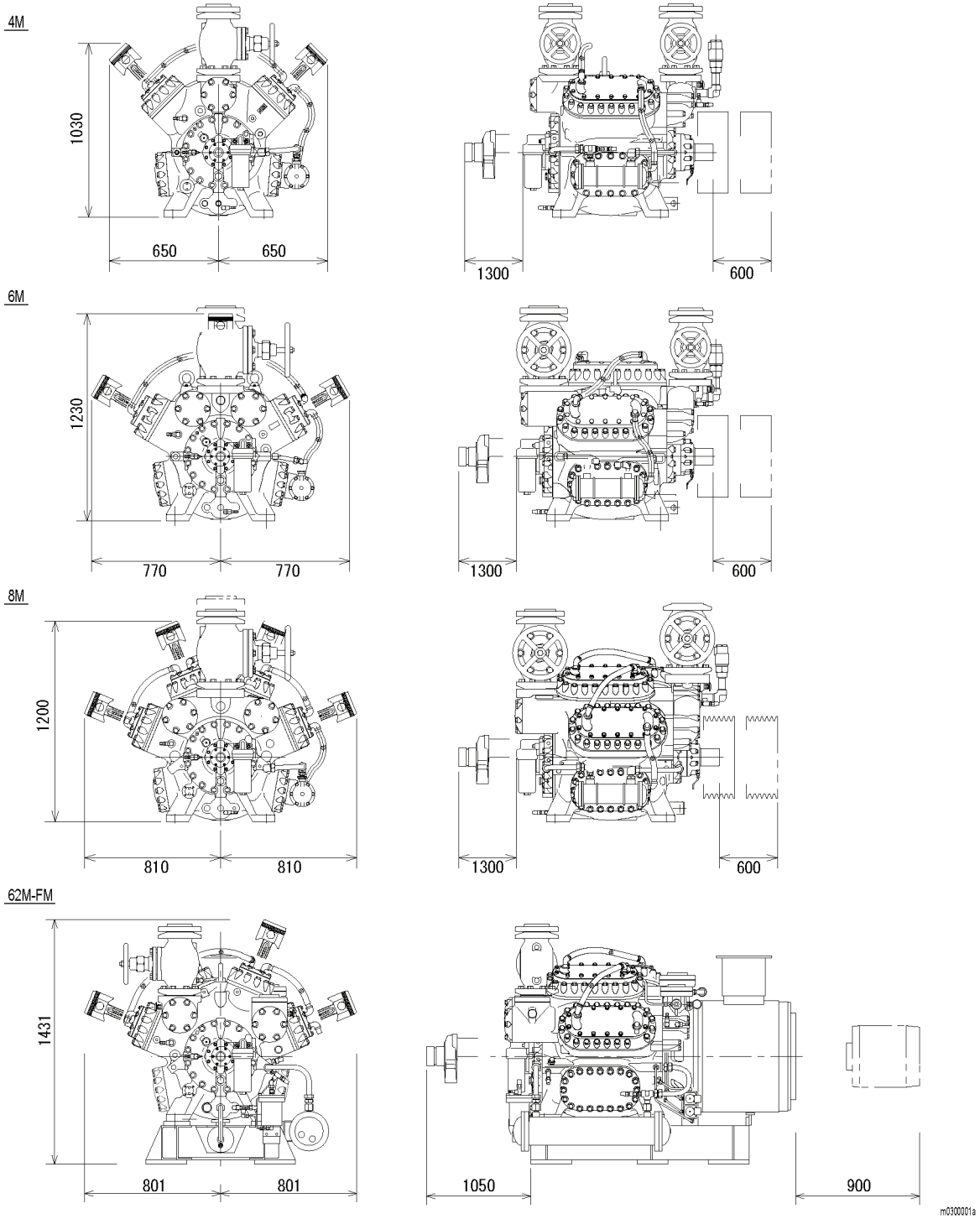


Fig. 3-1 Installation space

■ Illumination

Prepare illumination devices which allow easy operation, cleaning, maintenance, and inspection.

■ Ventilation

If natural ventilation is insufficient, install ventilation fans according to the regulations.

■ Cooling Water

Referring to chapter 7, secure cooling water necessary for your system.

■ Piping

Table 3-1 Connected piping list

		4M	6M	8M	62M
Suction gas	With suction shut-off valve	4 inch	5 inch		4 inch
	Without suction shut-off valve	ANSI #300 4 inch	ANSI #300 5 inch		ANSI #300 4 inch
Intermediate gas	With suction shut-off valve	—			3 inch
	Without suction shut-off valve	—			ANSI #300 3 inch
Discharge gas	With suction shut-off valve	4 inch		5 inch	2½ inch
	Without suction shut-off valve	ANSI #300 4 inch		ANSI #300 5 inch	ANSI #300 2½ inch
High pressure gauge connection port		φ6			
Intermediate pressure gauge connection port		φ6			
Low pressure gauge connection port		φ6			
Oil pressure gauge connection port		φ6			
Cooling water inlet		20A (Rc3/4)			
Cooling water outlet		20A (Rc3/4)			20A (Rc3/4)
Oil separator return inlet		Rc1/2			
Safety valve connection port		Rc3/4	Rc1	Rc1¼	High stage: Rc3/4 Low stage: Rc1

3.2.5 Installation

3.2.5.1 Installation

Check that mounting surfaces of the refrigerating, cold storage, and coolant systems to compressor are horizontal. If not, the compressor may be deformed by tightening bolts, and fail to operate normally.

3.2.5.2 Position of the Oil Returning Point in the Oil Separator / Procedure of Oil Returning

Use the float valve.

Do not return oil from the receiver/or chiller only from discharge oil separator.

3.2.5.3 Protection Switch

To protect the compressor and prevent accidents, attach the protection equipment below.

For details, refer to "1.4.5 Automatic Control and Protection Equipment of Refrigerating Machine".

- Low oil pressure failure protection equipment (OP)
- High pressure protection equipment (HP)
- Low pressure control equipment (LP)

3.2.5.4 Centering of the Compressor/Driving Machine and Attachment of the V-belt

CAUTION

- **To replace the V-belt with a new one, purchase the same set of belt as the current one, and replace the whole set at once.**
  Even if their nominal dimensions are the same, their actual lengths may slightly differ. In such case, operation force is applied only to the short belt. This may cause wear of the belt and abnormal vibration.
  Also, if old and new belts are used together, the difference of their wear amounts may cause abnormal vibration.
- **V-belt should be free from machine oil and lubrication oil. If those oils adhere to V-belt, wipe them off.**

【POINT】

- V-belts are set to proper tension on shipment of belt driven package during normal operation belts will stretch and should be tightened to ensure long life of all drive parts.

■ Centering and Attachment of V-belt

If the compressor is with common base, centering is performed on the V-belt before shipment. However, check the center again after installation.

1. String on the side of pulley to check that the refrigerating machine and the motor center core are parallel. If the center core is not in the correct position, it accelerates wearing the belt due to high-speed rotation, and shortens the life span of the compressor and motor by applying force to the bearings.

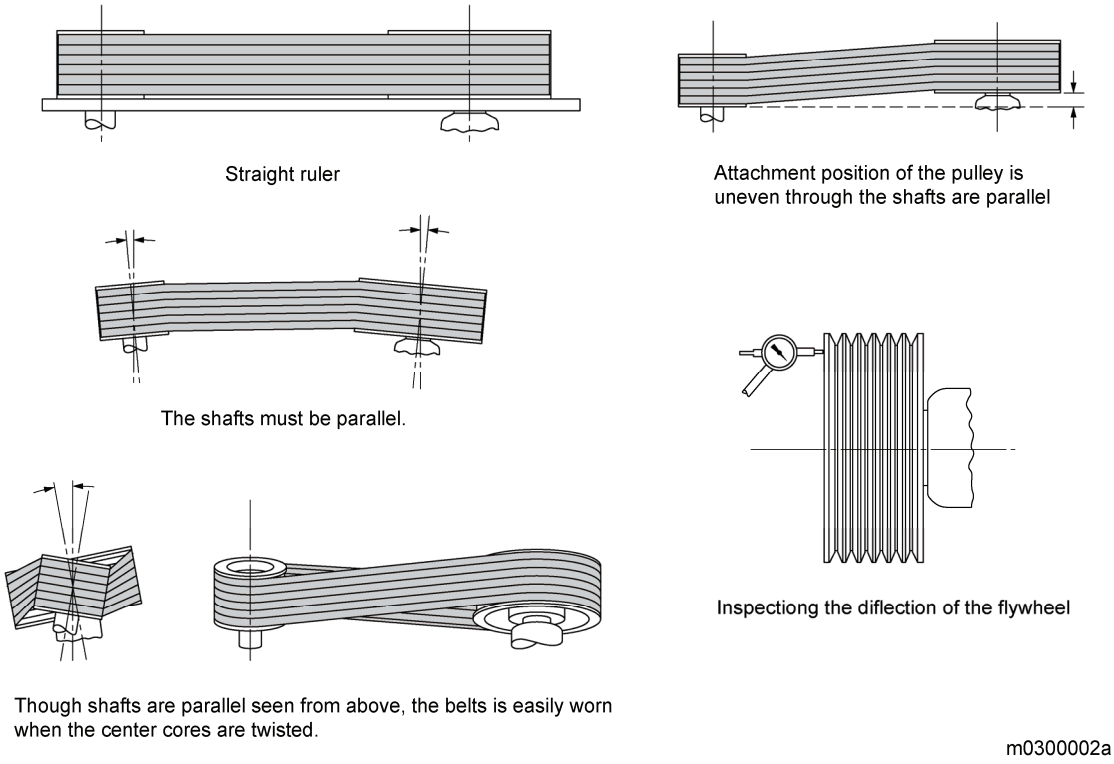

Straight ruler
Attachment position of the pulley is uneven through the shafts are parallel
The shafts must be parallel.
Inspectiong the diflection of the flywheel
Though shafts are parallel seen from above, the belts is easily worn when the center cores are twisted.
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Fig. 3-2 Centering of V-belt

For centering by driving the belt, strain a string on the side of flywheel and motor pulley.

Centering standard: L=1 mm or less

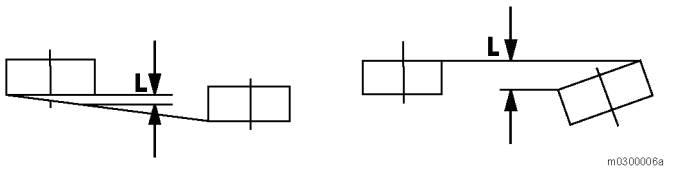


Fig. 3-3 Centering standard

2. Loosen the slide base of motor, move the refrigerating machine and the pulley closer to each other, and attach the V-belt to groove V while slacking the V-belt.
Check that the V-belt fits groove V, and pull the motor with the bolt so that the belt becomes tensioned.

Deflection = 0.008 × span length (mm) (Span length ≒ Center distance)

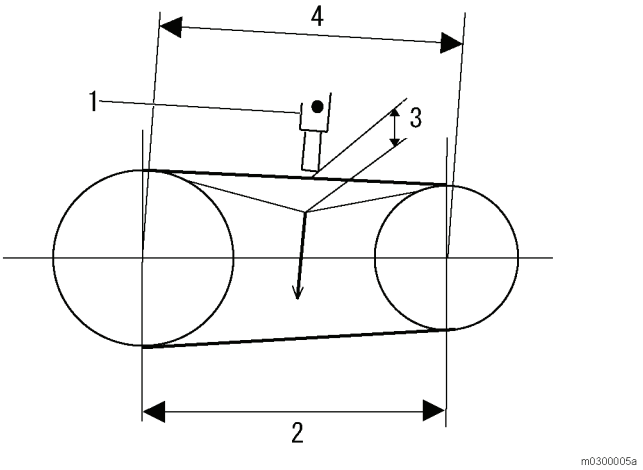


Fig. 3-4 Deflection

No.	Description
1	Tension meter
2	Center distance

No.	Description
3	Deflection
4	Span length

Table 3-2 Amount of deflection (mm)

Center distance (mm)	1000	1100	1200	1300	1400	1500	1600	1700
Deflection (mm)	8.6	9.5	10.4	11.3	12.2	13.0	13.9	14.9

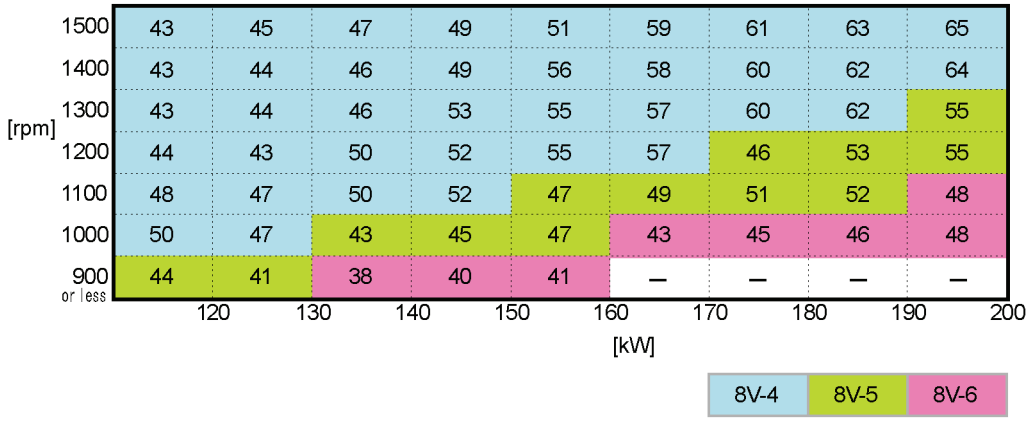
Table 3-3 Amount of tension load (N/belt)

Rotation speed of the compressor (rpm)	Tension load of new belt	Tension load at re-straining for the first time	Tension load at re-straining for the second time and after
1500	95～105	85～95	60～70
1400	90～100	80～90	60～70
1300	90～95	75～85	55～65
1200	80～90	70～80	50～60
1100	75～85	65～75	50～60
1000	75～85	65～75	50～60
900	65～75	55～65	40～50

Note 1: Re-tighten the belt for the first time after 2—3 hours from the starting the operation.

Note 2: Rotate the flywheel (pulley) to check the tension load of V-belt.

Note 3: When the belt is under the minimum tension load, make sure that the belt does not move excessively by operation, because the load fluctuates due to the load conditions.



(Motor : 4P x 50 Hz (1450 rpm), Center Distance : 1300 mm, Narrow Type Velt/8V, P.C.D.(Flywheel) : 475 mm)

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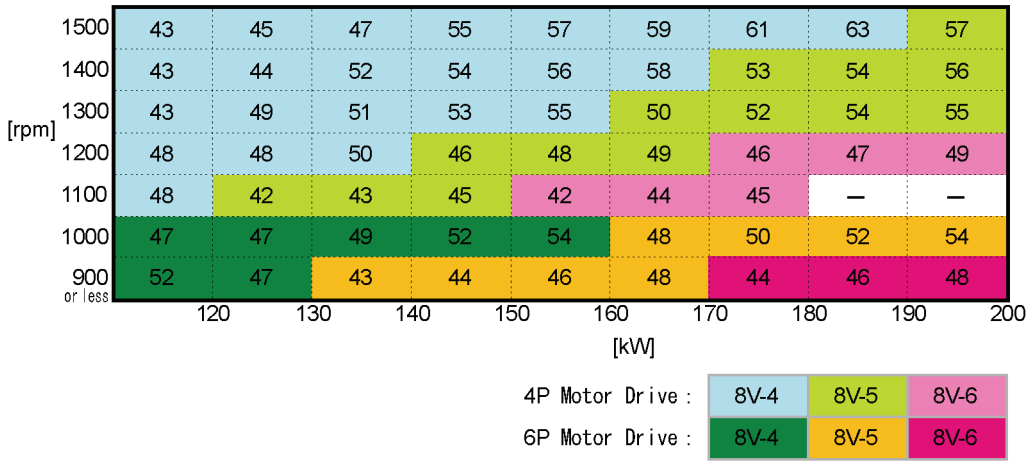

(Motor : 4P or 6P x 60 Hz (1200 or 1750 rpm), Center Distance : 1300 mm, Narrow Type Velt/8V, P.C.D.(Flywheel) : 475 mm)

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【POINT】

- After replacing the V-belt, operate the compressor for 2 to 3 hours, initial tension and friction occur to the new V-belt. Due to these and other causes such as peel-off of coating from flywheel, the tension load of V-belt decreases drastically to less than the minimum. If the V-belt is continuously used in this condition, the service life of V-belt is shortened by slipping. In addition to this, defects may occur such as excessive movement of V-belt, overturn and deviation caused by wear of belt on one side. Make sure to re-tighten the V-belt soon after operation.
- If the belt is replaced with a new one, operate the compressor with the new belt for 24—48 hours and check the tension again.

3.2.5.5 Centering of the Compressor/Driving Machine and Attachment of the Direct Coupling

■ **Section view for the direct coupling**

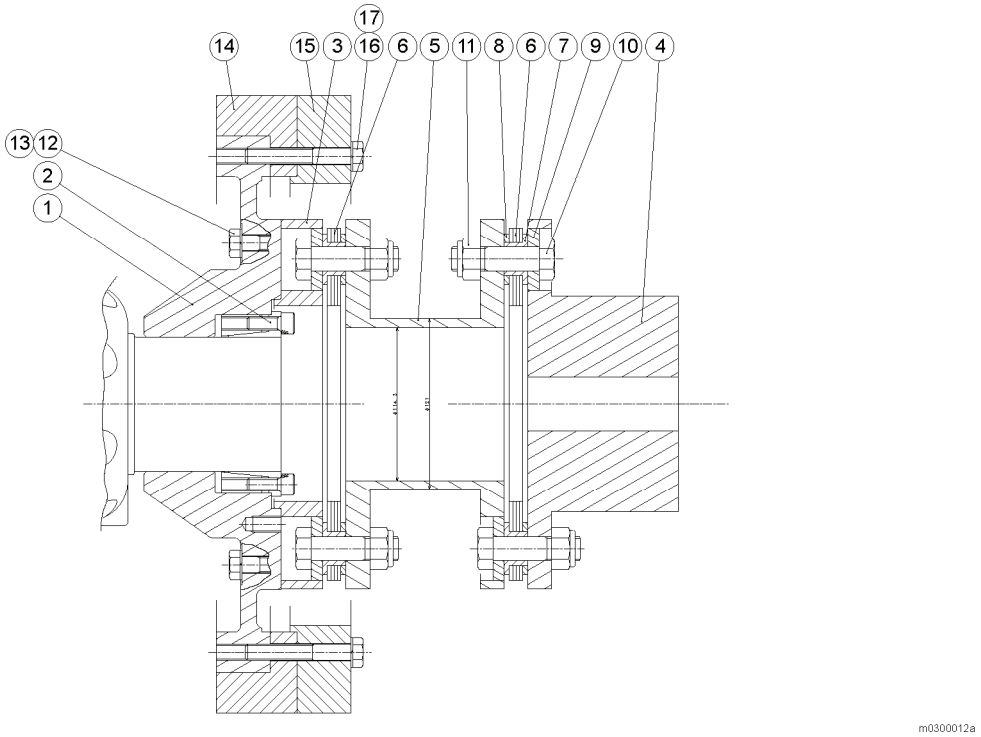


Fig. 3-5 Section view for the direct coupling

Part Number	Part name	Material	Remarks
1	Flywheel		
2	Mechlock		
3	Hub (compressor side)		
4	Hub (motor side)		
5	Spacer		
6	Coupling/insert		
7	Bushing		
8	Washer		
9	Overload washer		
10	Bolt		M18 × 1.5
11	Hexagon nut		M18 × 1.5
12	Bolt		M12 × P1.25 × L60
13	Spring washer		For M12
14	Sub ring 1		Common to B type
15	Sub ring 2		Common to B type
16	Sub ring fastening bolt		M12 × L80 – 8 8
17	Spring washer		For M12

■ Centering and Attachment of Direct Couplings

The attachment positions of compressor and motor are designated according to the center distance appropriate for attachment of couplings. Also, the difference of center core heights is within 0.1 mm by machining process of frames.

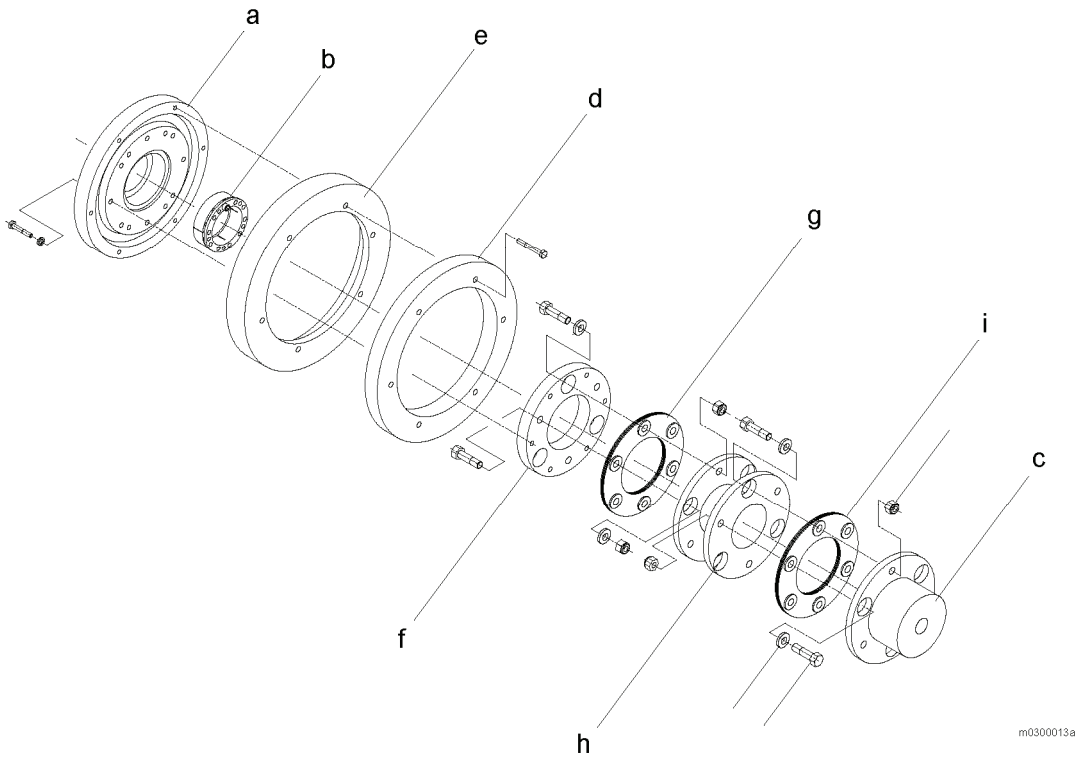


Fig. 3-6 Development view for the direct coupling parts

To align the center cores, correct the parallelism and deviation between left and right shafts.

1. Retain the compressor on the frame with bolts, and attach the flywheel (a) to the crankshaft with mechlock (b).

2. Set the dial indicator on the motor axle using a magnetic stand or others, so that the probe contacts the external diameter and surface of the flywheel (a) on the compressor side.

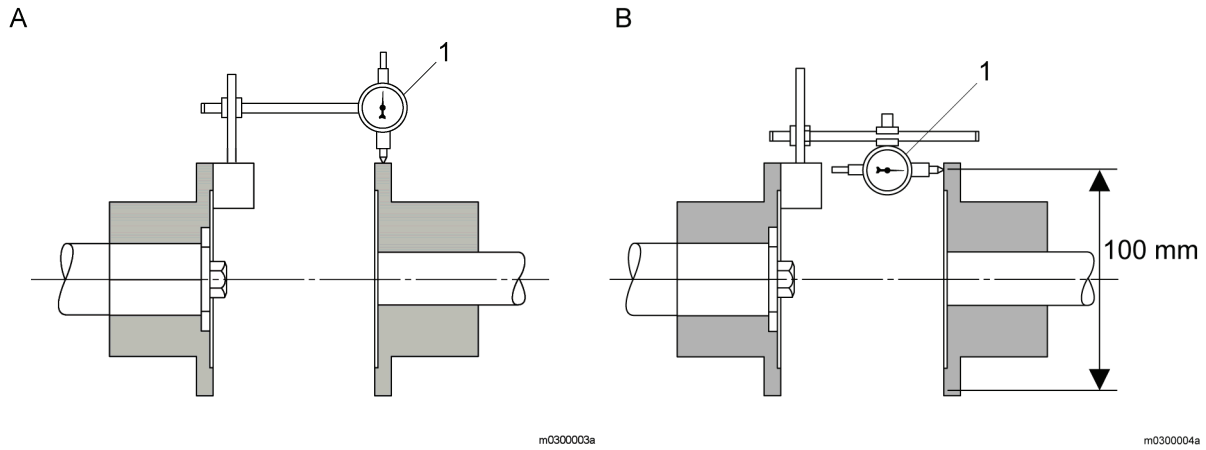


Fig. 3-7 Measurement of axle core

Symbol	Description
A	Measurement of core deviation
B	Measurement of angle deviation

No.	Description
1	Dial indicator

3. Read the scale of dial while rotating the motor axle. Then adjust the coupling hub by moving the motor so that the core runout of external diameter (core deviation) is 0.06 mm or less, and the deflection of hub face (angle deviation) is 0.03 mm (standard: diameter of 100 mm) or less.
4. When the alignment is within the specified measurements, tighten the motor on the frame. Tighten the flywheel, if any, on the hub on the compressor side with bolts.
5. Attach the hub (c) on the motor side to the axle.
6. Hang the sub ring 1 (e) and the sub ring 2 (d) on the hub (c) on the motor side.
7. Attach the coupling/insert (g) and the spacer (h) to the hub (f) on the compressor side, and assemble them. Attach the assembly to the flywheel (a).
   Insert the bolts from the back face (compressor side) of the flywheel (a), and tighten them.
8. Attach the sub ring 1 (e) and the sub ring 2 (d) hung on the hub (c) on the motor side to the flywheel (a) and tighten with bolts.
9. Retain the coupling/insert (i) on the motor side to the spacer (h).
   When attaching the hub (c) on the motor side and coupling/insert (i), move the hub (c) on the motor side to the gap in which the washers fit, and adjust the interval between the coupling hubs.
   If the washers do not fit in easily, or there are gaps between the coupling/insert, washers, and hub face, force in the axle direction (thrust) is applied. Prevent this thrust from applying.
10. Tighten the hub (c) on the motor side on the axle.
11. Tighten all the nuts at the specified torque again.

3.2.5.6 Piping

Vibration generated from the compressor is transmitted to the building via two systems: substruction and piping. Take into consideration the piping support to prevent resonance in the building.

■ Refrigerant Piping

Observe the followings when connecting the refrigerant piping.

- Compressor is one of the few components with moving parts in the refrigerating, cold storage, and air conditioning systems. Moving part should be free from dust. During piping work, do not put tools such as scale into it.
- The compressor may contain nitrogen gas infused before shipment to prevent from rusting. Do not open the suction and discharge valves unless it is required.
- The piping must be free from moisture. It may cause troubles after starting operation. Assemble the piping in dry condition.
- If the suction piping is assembled inappropriately, it may cause troubles such as oil in the piping not returning to the compressor, and liquid compression.
- When connecting the piping to the compressor, select a pipe whose size is the same as the connection of compressor. If the pipe size is smaller than the connection of compressor, it restricts the oil or refrigerant flow, resulting in troubles.
- Make sure to attach supports to the piping so that excessive force is not applied to the compressor. Also, when a vibration-proof base is used, install flexible tubes on the piping.
- Separate pipes on which dew may form.

■ Cooling Water Piping

CAUTION

- **Do not divide the cooling water system from the oil cooler to the head jacket. This is dangerous because the difference of pressure loss (resistance) restricts the cooling water flow, resulting in failure to cool necessary sections.**
- **Always flow cooling water during operation of compressor.**

For compressor with water cooled type oil cooler and water cooling head cover, observe the following when performing piping for cooling water.

- For automatic operation, attach solenoid valves so that cooling water does not flow while the motor is not in operation. If cooling water flows while the motor is stopped, refrigerant in the compressor is condensed, resulting in increase of oil consumption, and possible compressor damage from hydraulic.

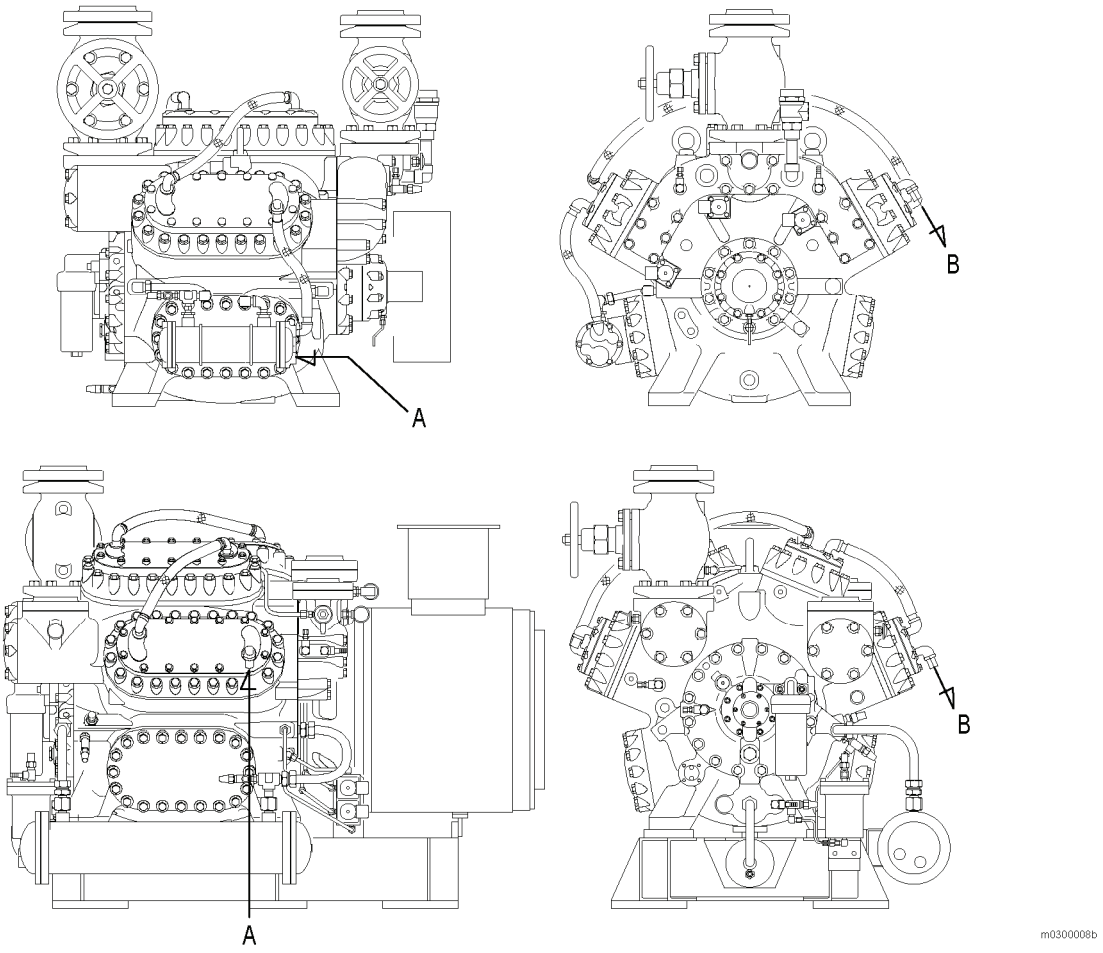


Fig. 3-8 Cooling water piping (internal oil cooler specification)

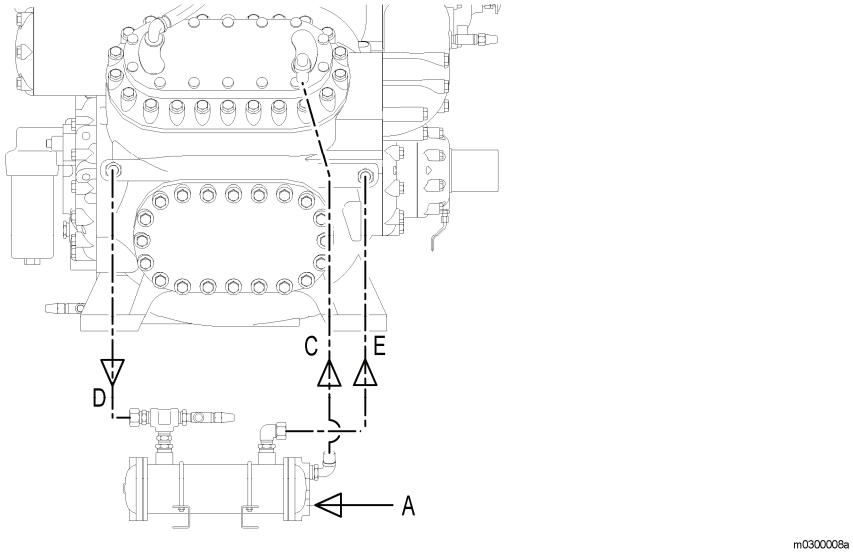


Fig. 3-9 Cooling water piping (external oil cooler specification)

Symbol	Usage	Size	Remarks
A	Cooling water inlet 20A	20 A	
B	Cooling water outlet 20A	20 A	
C	Cooling water piping 20A	20 A	To the head cover
D	Oil piping	20 A	From the crankcase
E	Oil piping	20 A	To the crankcase

3.2.5.7 Charging of Refrigerant Oil

Refer to "4.1.3 Initial Charging Method".

3.2.6 Check after Installation

Referring to the items described below which should be performed after installation of compressor, formulate a list and procedure to check the refrigerating, cold storage, and air conditioning systems you use, based on their specification.

■ Automatic Control Connections

- Wiring between the control board and each switch
- Activation mode (auto/semi-auto) and rotational direction of motor
- Insulating resistance of motor

■ Operation Test of Protection Equipment

For details, refer to "1.4.5 Automatic Control and Protection Equipment of Refrigerating Machine".

⚠ WARNING

- **If operation test of high pressure protection equipment (HP) is performed at the setting value, it may cause explosion of devices. Make sure to perform the test at the normal operation pressure or below.**

- Low oil pressure failure protection equipment (OP)
- High pressure protection equipment (HP)
- Low pressure control equipment (LP) and unloader solenoid valve

■ Refrigerant Leakage Test

Leakage test on your systems to ensure no loss of refrigerant.

3.3 Documents Related to Installation *1

Note *1: The followings are reference values of individual compressor. They may differ from the actual values. If there are any questions, please contact your local sales offices or service centers.

■ Weight and Dimensions

Fig. 3-10 Weight and dimensions

		4M	6M	8M	62M	62M-F
Dimensions (mm)	H	1254	1269	1329	1185	1406
	W	1211	1247	1283	1291	1713
	D	1019	1147	1147	1220	1229
Mass *2 (kg)		1300	1580	1830	2000	2700

Note *2: The above values include the weight of water cooling head cover, oil cooler, and flywheel.

■ Lifting Positions/Gravity Center Positions/Lifting Mode

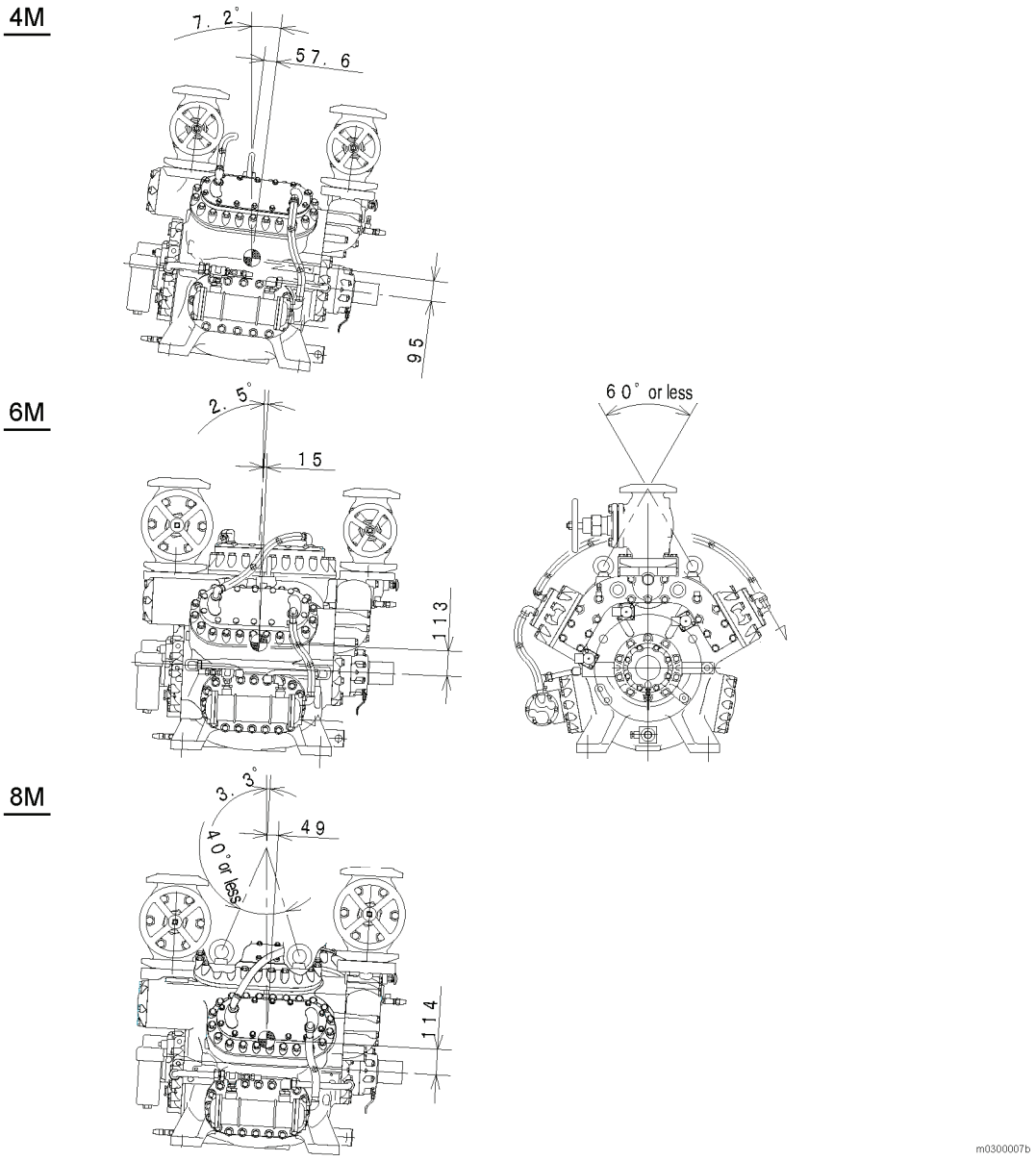


Fig. 3-11 Lifting positions/gravity center positions/lifting mode

4 Operation of the Compressor and the System

4.1 Refrigerant Oil

The refrigerant oil is used for lubricating the moving parts of the compressor, preventing abnormal wear, and cooling each section.

The following oil properties are required:

- There should be an appropriate viscosity under temperature and pressure conditions within the range of use.
- The oil should flow even under the low temperature conditions (within the range of operating temperature for the refrigerant system).
- The oil should be chemically–stabilized so that it does not corrode or transelement the components (such as metals or rubbers).
- Wax should not be separated from the oil even under low temperature.
- Sludge and carbon should not be generated easily even under high temperature.
- Water should not be contained in the oil.

4.1.1 Precautions for Selecting the Refrigerant Oil

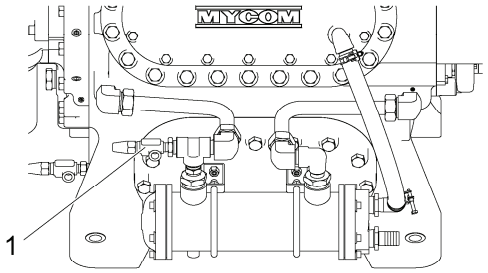
- Brands to be used differ depending on the types of refrigerant. For details, contact your sales office or Mayekawa representative.
- For NH_3 and coolant, do not use Polyolester (POE) and Polyalphaolefin (PAO).
- Naphthenic based mineral oil of ISO–VG 46-68 is recommended.
- The viscosity of the oil selected must stay 20—70 cSt under usage condition.
- The circulation of the refrigerant oil for the overall equipment must be taken into consideration. After the refrigerant oil lubricates/cools each section of the compressor, it returns to the oil tank of the crankcase. However, some of the oil is discharged together with the refrigerant. Most of the oil discharged from the compressor is captured by the oil separator while some of it flows to the condenser or evaporator. As described above, there should be sufficient flow ability and stability inside each machine with the different temperature zones.

■ To change the brand of the refrigerant oil:

- Changing the existing refrigerant oil with other brand oil may cause an unexpected problem due to mixing of new and old oils. Ensure sufficient oil flushing is completed before running compressor with oil approved by Mayekawa.
- If the manufacturers are different, contact both of them to confirm whether changing the oil is going to cause problems. The same confirmation is required for changing the brand even if it is of the same manufacturer.
- There is no problem in changing the viscosity level within the same brand. However, the viscosity level must match the operation conditions.
  [Example] SUNISO 3GS → SUNISO 4GS

4.1.2 Initial Charging Method

When charging the oil initially or changing the oil after overhaul, supply the oil from the initial supply port to fill the oil cooler, oil filter, and oil passages with the oil.



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No.	Description
1	Oil supply port

4.1.3 Replenishment of the Refrigerant Oil

The refrigerant oil level lowers gradually during the operation. While the oil level can be checked through the oil sight glass, replenish the oil in the following manner.

CAUTION

- **When replenishing the oil, be careful so that the oil will not be contaminated by air or water.**
- **When replenishing the refrigerant oil, use clean oil with no foreign materials contained.**
- **To prevent bubbling in the crankcase, supply the oil gradually.**
- **To avoid absorption of water vapor in the air, store the refrigerant oil with it sealed until it is used.**

<Replenishment Method during Operation (Example)>

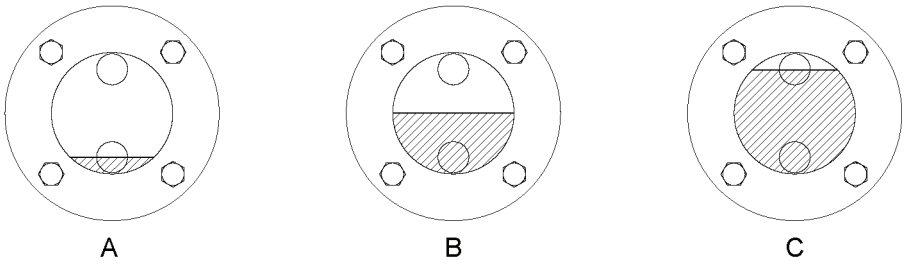
1. Close the compressor suction shut–off valve gradually until suction pressure becomes slightly vacuum (approx. –0.026 MPaG (–20 cmHg)).
2. The oil will be vacuumed gradually from the oil supply/drain valve (oil drain valve) on the compressor.
3. After the specified amount of oil is replenished, close the oil supply/drain valve completely.
4. Open the suction shut–off valve gradually, and change the equipment to the steady operation.

4.1.4 Set Oil Pressure

Adjust the oil pressure to 0.15—0.25 MPa above suction pressure (maximum of 0.4 MPa) using the oil pressure regulating valve.

4.1.5 Oil Quantity

Quantity of refrigerant oil in the crankcase is judged by the oil level viewed through the oil sight glass.



Symbol	Oil Quantity
A	Lower limit
B	Standard
C	Upper limit

4.2 Initial Operation

When approx. 24 hours have passed after the first startup of the compressor, foreign materials such as dust, scale, rust, and sand in the piping can accumulate in the compressor because they flow with the refrigerant gas. Fine foreign materials that can not be removed by the suction filter will mix into the oil, resulting in failure or abnormal wear.

Suction of foreign materials into the compressor will continue until all foreign material has been pulled into the compressor, the greatest amount is suctioned after the initial startup.

Presence of foreign materials can be checked by inspecting the suction filter and checking the contamination of oil.

The oil in the crankcase can be the first sign of contamination of the refrigeration system. Therefore, if the oil stays clear for a long period of time, it can be judged that inside of the equipment is also clean. If the oil seems to be slightly blackened or turbid in brown, the oil is contaminated with foreign materials in the equipment. Replace the oil as soon as possible so as to prevent foreign materials from penetrating into the sliding section of the compressor. Take sufficient care of the following two points:

- Inspection/cleaning of the filter and replacement of the oil
  - Cleaning of the filter may not be required when inside of the refrigerant cycle in the refrigerating, cold storage, and air conditioning systems are clean.
  - Replace the oil filter elements if they are soiled. The soiled elements cannot be reused even if they are cleaned.
- Watch for any abnormal sound or temperature of the compressor.

【POINT】

- Cleaning the oil and suction filters requires processing of the refrigerant and opening of the compressor. For processing of the refrigerant and assembly/disassembly of the compressor, refer to "Chapter 5. Maintenance".

Table 4-1 Reference of the oil replacement and filter inspection

Elapsed time	Replacement of oil and cleaning of oil strainer	Inspection/ replacement of oil filter	Cleaning of suction filter	Inspection of magnet
After completion of refrigerant charging operation	○	○	—	—
After completion of trial operation	○	○	○	—
100 hours after starting operation	○	○	○	○
500 hours after starting operation	○	○	○	○
Every 1000 hours	○	○	○	○
Note	If contamination of the refrigerant oil or clogging of the filter is found, perform oil replacement or inspection/cleaning and replacement regardless of the above conditions.			

4.2.1 Initial Operation Method

1. Before starting operation, rotate the crankshaft (manually) or perform inching (operation of 1—2 sec) twice to check that the oil pressure gauge operates. Check that the both surfaces of the rotation side glass lower slightly as well.
2. Operate the compressor.
3. Perform the initial operation according to "Table 4-1 Reference of the oil replacement and filter inspection".

4.3 Operation Order of the Unloader

In the figure, ① indicate the cylinder number, and [1] indicate the unloader piston number.
"ON" in the table indicates loading (energized), and "OFF" indicates unloading (not energized).

4M

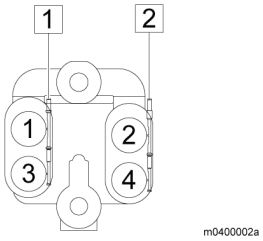


Fig. 4-1 Operation order of the capacity control (4M)

Table 4-2 Loading rate (4M)

Cylinder No.	Unloader piston number	0%	50%	100%
1	1	Stop	ON	ON
2	2		OFF	ON
3	1		ON	ON
4	2		OFF	ON

6M

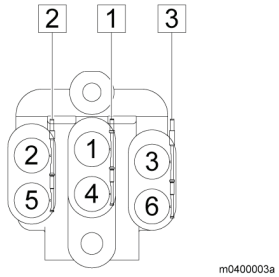


Fig. 4-2 Operation order of the capacity control (6M)

Table 4-3 Loading rate (6M)

Cylinder No.	Unloader piston number	0%	33%	66%	100%
1	1	Stop	ON	ON	ON
2	2		OFF	ON	ON
3	3		OFF	OFF	ON
4	1		ON	ON	ON
5	2		OFF	ON	ON
6	3		OFF	OFF	ON

8M

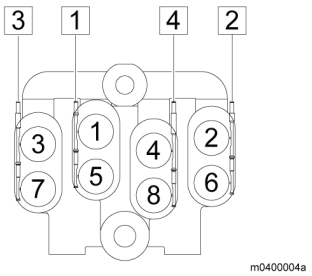


Fig. 4-3 Operation order of the capacity control (8M)

Table 4-4 Loading rate (8M)

Cylinder No.	Unloader piston number	0%	25%	50%	75%	100%
1	1	Stop	ON	ON	ON	ON
2	2		OFF	ON	ON	ON
3	3		OFF	OFF	ON	ON
4	4		OFF	OFF	OFF	ON
5	1		ON	ON	ON	ON
6	2		OFF	ON	ON	ON
7	3		OFF	OFF	ON	ON
8	4		OFF	OFF	OFF	ON

62M

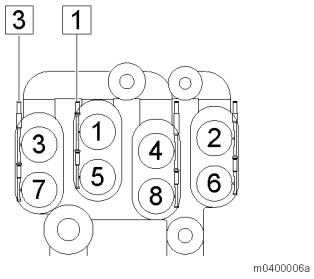


Fig. 4-4 Operation order of the capacity control (62M)

Table 4-5 Loading rate (62M)

Cylinder No.	Unloader piston number	0%	33%	66%	100%
1	1	Stop	OFF	OFF	ON
2	—		ON	ON	ON
3	3		OFF	ON	ON
4	—		ON	ON	ON
5	1		OFF	OFF	ON
6	—		ON	ON	ON
7	3		OFF	ON	ON
8	—		ON	ON	ON

4.4 Operation Notices

Notices for operation are as follows.

4.4.1 Start/Stop Limitation

To use the compressor normally, number of start/stop times and the stop time are specified as follows.

Table 4-6 Specification for number of start/stop times and the stop time

No.	Item	Qty.	Remarks
1	Number of start/stop times	3 times/hour	
2	Stop time	At least 5 min	
3	Minimum operation time	At least 15 min	
4	Unloader operation interval	At least 3 min	To operate the compressor at 0% load, contact our sales offices or service centers.
5	Oil level	Oil sight glass10—90%	
6	Minimum oil supply temperature	30°C	This should be higher than ambient temperature.
7	Maximum oil supply temperature	60°C	
8	Maximum oil pump differential pressure	0.4 MPa	
9	Maximum discharge temperature	160°C	
10	Minimum suction pressure	0.02 MPaA	
11	Maximum high–low differential pressure (Pd–Ps)	2.0 MPaA	
12	Degree of superheat	20°C or less	Do not allow liquid back to occur.

4.4.2 Action for Stopping the Compressor for Long Period of Time

If the compressor will be stopped for a long period of time, close the suction (side)/discharge (side) shut off valves, then set the motor (main power), heater power, and control board power to "OFF".

4.4.3 Operation after the Compressor has been stopped for Long Period of Time

Refer to "4.2.1 Initial Operation Method".

5 Maintenance

5.1 Safety Precautions for Maintenance

- Be careful so as not to receive an electrical shock when turning on/off the power of each unit.
- Before performing maintenance, turn off the motor (main power) and control power, and then perform lockout and tagout.
- Before performing maintenance, turn off the power of instruments such as a heater. Be careful so that the power of instruments does not turn on during maintenance.
- Check that pressure inside the refrigerating machine is at atmospheric pressure before disassembling the machine for inspection.
- After temperature of the hot sections (such as head cover) is decreased to normal, perform the work.
- When handling the heavy objects, take a sufficient care and perform the work using an auxiliary tool such as a stud bolt.
- Always handle the heavy objects with at least one other person.
- Before performing the work together with at least one other person, thoroughly confirm each other's work details and acknowledge other worker's movement.
- Replace the parts with the MAYEKAWA genuine parts.
- When disassembling/assembling the refrigerating machine, use a normal tool that has been designated.
- Electrical works should be performed only by electrical engineers.

5.2 Periodic Inspection

【POINT】

- Record the operation condition of the compressor, and details of periodic inspection and maintenance in the operation log. By recording the operation logs correctly, the refrigerating, cold storage, and air conditioning systems can be operated efficiently and safely. This will be useful for investigating the cause immediately and adequately in case of equipment failure.

5.2.1 Daily Inspection

【POINT】

- Perform daily inspection every 2—3 hours, and record the result in the operation log.

Item		Remarks
Compressor	Suction pressure	
	Discharge pressure	
	Oil supply pressure	
	Suction temperature	
	Discharge temperature	
	Fluid level of the receiver	
	Oil level of the crankcase (oil quantity)	Refer to "4.1.6 Oil Quantity".
	Oil temperature	
	Abnormal noise	
	Abnormal vibration	
	Cooling water hose	For the specification with the oil cooler and water cooling head jacket
	Cooling water hose band	For the specification with the oil cooler and water cooling head jacket
Others	Current value applied to the electrical equipment	
	Flow rate of cooling water for the condenser	
	Temperature inside the mechanical room	
	Replenishment of refrigerant	Refer to "3.2.7 Filling of Refrigerant".

5.2.2 Monthly Inspection

【POINT】

- Verify the operation of the pressure switch using a pressure tester. Do not increase the actual discharge pressure.

Inspection Items		Remarks
Compressor	Looseness of couplings	Refer to "3.2.5.4 Centering of the Compressor/Driving Machine and Attachment of the V-belt".
	Belt tension	Refer to "3.2.5.4 Centering of the Compressor/Driving Machine and Attachment of the V-belt".
	Cracking of the belt	Refer to "3.2.5.4 Centering of the Compressor/Driving Machine and Attachment of the V-belt".
	Inspection of the protection switch operation	
	Oil leakage from the shaft seal	8 cc/h or less: Normal
		8—12 cc/h or less: To be monitored
		12 cc/h or more: To be inspected
	Inspection and cleaning of the cooling systems	The specification with the water-cooled condenser: A large amount of water stain and scale may be adhered to the condenser depending on the cooling water quality. In such a case, a regular cleaning of the cooling pipes in the condenser is required.
	Analysis of lubricant	Refer to "4.1.2 Refrigerant Oil Control Standard".

5.2.3 Biannual Inspection

Inspection Items		Remarks
Compressor	Pressure gauge	Calibrate the gauges using a standard gauge. Replace if it has a margin of error of minimum scale or more.
	Thermometer	Replace if it has a margin of error of minimum scale or more.

5.3 Maintenance (Overhaul)

CAUTION

- **Frequency of the maintenance differs depending on the equipment model, refrigerant, and number of rotations, usage condition, equipment status, and oil types. The parts are replaced at your expense even when they are damaged before the provided time has passed.**
- **Normally, replace the M series consumable materials at the maintenance (overhaul).**

5.3.1 Maintenance Period and Operation Conditions

The reference inspection and maintenance timings are as follows:

Preconditions

(1) The operation conditions are within the specified range of use.

(2) Number of start/stop is within the specified range.

Table 5-1 Reference of the first maintenance period

Rotation Speed (N) Range (rpm)	First maintenance period	Remarks
800≤N<1000	Whichever comes first: Operation time of 8000 hours or 1 years	
1000≤N<1200	Whichever comes first: Operation time of 6000 hours or 1 years	
1200≤N<1500	Whichever comes first: Operation time of 4000 hours or 1 years	

Table 5-2 Reference of the second maintenance period

Rotation Speed (N) Range (rpm)	Second maintenance period	Remarks
800≤N<1000	Whichever comes first: Operation time of 16000 hours or 2 years	
1000≤N<1200	Whichever comes first: Operation time of 12000 hours or 2 years	
1200≤N<1500	Whichever comes first: Operation time of 8000 hours or 2 years	

5.3.2 First Maintenance Period

Remove the shaft seal cover, head cover, and hand hole cover, then remove the piston and connecting rod. When no abnormality is found, it is not necessary to remove the crankshaft and bearing housing.

Inspection Sections	Inspection Items	Remarks
Plate valve	Replacement	
Plate valve spring	Replacement	
Cylinder sleeve	Inspection	To be replaced if any abnormality is found
Piston	Inspection	To be replaced if any abnormality is found
Piston ring	Replacement	
Piston pin	Inspection	To be replaced if any abnormality is found
Connecting rod bearing halves	Replacement	
Crankshaft pin	Inspection	To be replaced if any abnormality is found
Mechanical seal assembly	Inspection	To be replaced if any abnormality is found
Oil control ring (3rd)	Replacement	
Needle bearing for high grade connecting rod	Replacement	
Gasket	Replacement	
"O"ring	Replacement	
Suction filter	Cleaning	
Oil strainer	Cleaning	
Oil filter	Replacement	
Lubricant	Replacement	
Motor	Replenishment of grease	Refer to the operation manual of electrical equipment. If no particular description is provided, it is recommended to replenish the grease every 1000 hours.

5.3.3 Second Maintenance Period

Perform the first inspection items, and then the following items.

Remove the crankshaft and bearing housing.

The second inspection items are as follows.

Inspection Sections	Inspection Items	Remarks
Main bushing	Inspection	To be replaced if any abnormality is found
Thrust roller bearing	Inspection	To be replaced if any abnormality is found
Thrust washer	Inspection	To be replaced if any abnormality is found
Crankshaft	Inspection	To be replaced if any abnormality is found
Other parts	Inspection	To be replaced if any abnormality is found

5.4 Refrigerant Oil Control Standard

The refrigerant oil, to which the control standard is applied, is classified as follows:

1. Mineral oil: Naphthene series, Synthetic oil: Alkyl benzene (AB), Polyalphaolefin (PAO)

2. Synthetic oil: polyalkylene glycol (PAG) (Applicable refrigerant is NH_3.)

Each item and standard is as follows. The control standard may be changed without notice depending on the performance.

Table 5-3 ***1.*** Mineral oil: Naphthene series, Synthetic oil: Alkyl benzene (AB), Polyalphaolefin (PAO)

Item	Standard
Color phase	ASTM color standard: 6.0 or less
Total acid value	0.3 mg·KOH/g or less
Kinetic viscosity	Amount of change must be within ±15% of the new oil.
Water amount	100 ppm or less
Degree of contamination	Degree of contamination measured by mass method (millipore value) is 15 mg/100 m or less.

Table 5-4 ***2.*** Synthetic oil: Polyalkylene Glycol (PAG) *3 (Applicable Refrigerant is NH_3.)

Item	Standard
Color phase	ASTM color standard: 4.0 or less
Total acid value	0.1 mg·KOH/g or less
Kinetic viscosity	Amount of change must be within ±15% of the new oil.
Water amount	2000 ppm or less *1
Degree of contamination	Degree of contamination measured by mass method (millipore value) is 15 mg/100 m or less *2

*1 This is a reference value because moisture may be included during sampling due to its high absorbability. In the NH_3 refrigerant, NH_3 may be detected as water. If the amount is over this value by repeating the sampling for several times, it should be taken as the control standard is exceeded.

*2 It is assumed that the following types of the oil filter are used: Paper filter (Filtering grain size of approx. 10 μm) for fluorocarbon, paper filter or metallic mesh filter (300 meshes) and bypass filter (Filtering grain size of approx. 3 μm) for NH_3

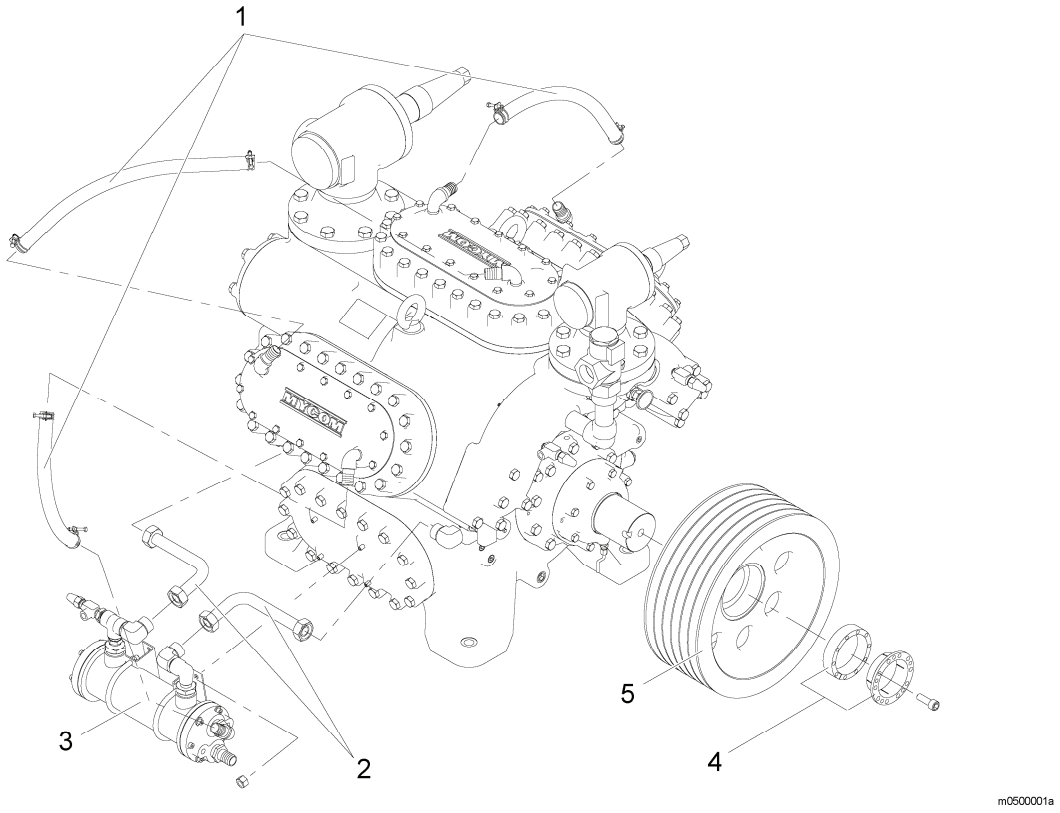
*3 For NH_3 + PAG, the rust is easily caused inside the equipment due to water absorption. Because the cleaning effect of PAG is higher than other conventional mineral oil, the rust in the equipment is easily carried into the compressor so that the degree of contamination tends to increase at the beginning of the operation. Therefore, it is recommended to replace the oil with new one after 2000—3000 hours have passed since the operation start. To prevent water adsorption while charging the oil, it is desirable to avoid a rainy day. Complete charging of the oil within 15 min after the pail can is open.

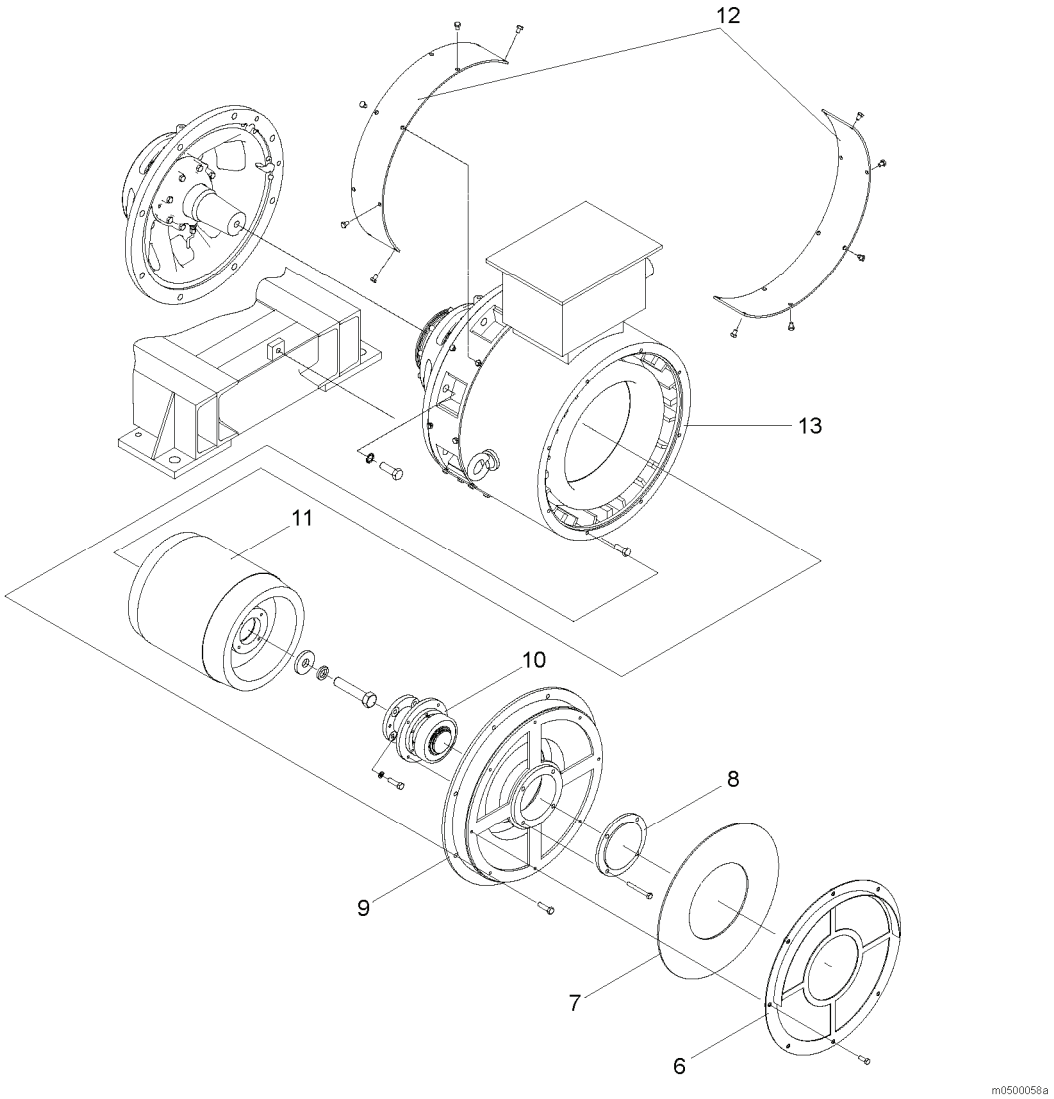
5.5 Disassembly/Assembly

5.5.1 Exterior Equipment

1. Release the residual pressure, and discharge the refrigerant oil from the crankcase.

2. Discharge the refrigerant oil from the oil cooler.





Steps	Description	Part No.
1	Blade hose	HT-19
2	Pipe, oil cooler (Refer to "Attentions for Removing the Oil Cooler Piping/Water Cooled Type Oil Cooler".) (Refer to "Attentions for Attaching the Oil Cooler Piping/Water Cooled Type Oil Cooler".)	HT-12
3	Oil cooler (water cooled) (Refer to "Attentions for Removing the Oil Cooler Piping/Water Cooled Type Oil Cooler".) (Refer to "Attentions for Attaching the Oil Cooler Piping/Water Cooled Type Oil Cooler".)	185
4	Mechlock (Refer to "Attentions for Removing the Mechlock".) (Refer to "Attentions for Attaching the Mechlock".)	4
5	Flywheel (Refer to "Attentions for Removing the Flywheel".) (Refer to "Attentions for Attaching the Flywheel".)	707

Steps	Description	Part No.
6	Air filter cover	
7	Air filter	
8	Motor end bearing cover	
9	Motor cover	
10	Motor end bearing assembly (Refer to "Attentions for Removing the Motor End Bearing Assembly".)	
11	Motor rotor (Refer to "Attentions for Removing the Motor Rotor".) (Refer to "Attentions for Attaching the Motor Rotor".)	
12	Side cover	
13	Motor cage (Refer to "Attentions for Removing the Motor Cage".)	

3. Remove the parts in the order shown in the figure.

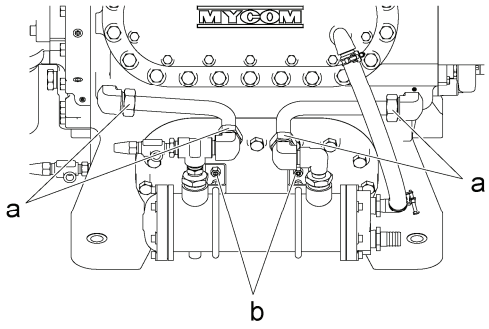
4. Attach the parts in the reverse order of removal.

5. Apply the refrigerant oil. (Refer to "4.1.3 Initial Charging Method".)

5.5.1.1 Attentions for Removing the Oil Cooler Piping/Water Cooled Type Oil Cooler

【POINT】

- While removing the water cooled type oil cooler and oil cooler piping, the refrigerant oil remaining in the piping may leak from the connection port. Place a waste cloth over the connection port.



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1. After loosening the oil cooler piping nuts (a), loosen the tightening nuts of the water cooled type oil cooler (b).

2. Remove the oil cooler piping.

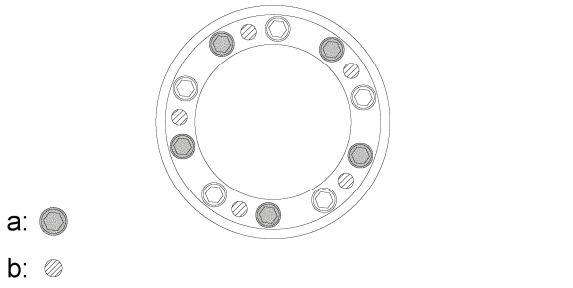
3. Remove the tightening nuts of the water cooled type oil cooler to remove the cooler.

5.5.1.2 Attentions for Removing the Mechlock

1. Loosen all the mechlock retaining screws.

【POINT】

- If all the mechanical lock retaining screws are removed, the parts at the front and rear of the mechlock will be separated so that the parts at the rear cannot be removed.



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2. Remove the five mechlock retaining screws (a).

3. Insert the removed five retaining bolts into the service holes (b), tighten them, and remove the mechlock.

5.5.1.3 Attentions for Removing the Flywheel

⚠ CAUTION

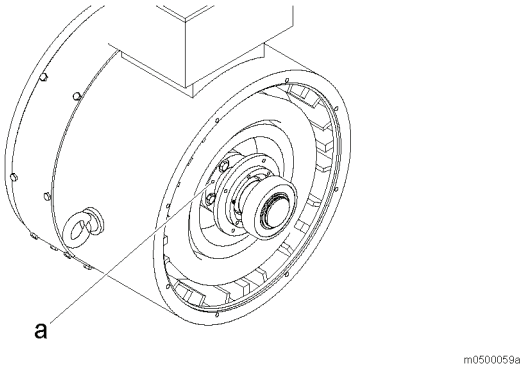
- **The flywheel weighs 100 kg. Handling it inappropriately may cause injury. Remove the flywheel in an appropriate manner with at least one other person.**

5.5.1.4 Attentions for Removing the Motor End Bearing Assembly

1. Remove the motor end bearing assembly hexagon head screw.

【POINT】

- To remove the motor end bearing assembly, insert the motor end bearing assembly hexagon head screw into the service hole (a) and tighten it. (There are two holes diagonally.)



2. Remove the motor end bearing assembly.

5.5.1.5 Attentions for Removing the Motor Rotor

⚠ CAUTION

- **The motor rotor weighs 250 kg. Handling it inappropriately may cause injury. Attach the motor rotor in an appropriate manner with at least one other person.**

1. Loosen the set bolts, and remove the set screws together with the spring washer and the flat washer. Attach the rotor extraction shaft (a) to the shaft instead.

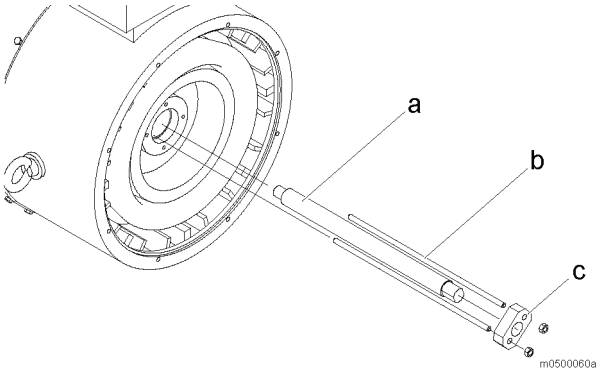
2. Attach the rotor extraction screw (b) to the rotor.

3. Attach the rotor extraction arm (c) to the rotor extraction shaft and the rotor extraction screw.

4. Attach the rotor extraction arm fastening nut.

5. Evenly tighten the rotor extraction arm fastening nuts, and remove the tapered engagement between the motor rotor and the crankshaft.

6. Pull out the motor rotor by sliding on the rotor extraction shaft.

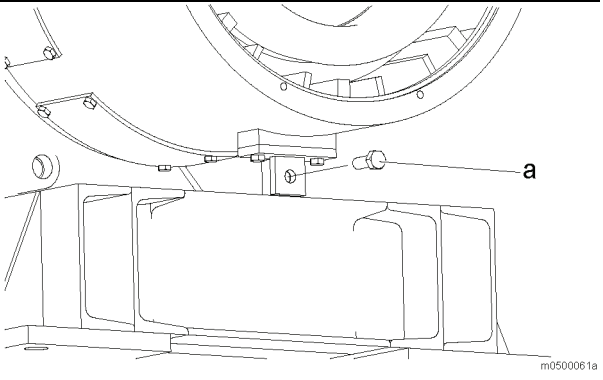


5.5.1.6 Attentions for Removing the Motor Cage

⚠ CAUTION

- **The motor cage weighs 430 kg. Handling it inappropriately may cause injury. Attach the motor cage in an appropriate manner with at least one other person.**

1. Remove the screw (a) fixing the motor cage to the frame before removing the motor cage hexagon head screw.



5.5.1.7 Attentions for Attaching the Flywheel

CAUTION

- **The flywheel weighs 100 kg. Handling it inappropriately may cause injury. Attach the flywheel in an appropriate manner with at least one other person.**

1. Apply oil on the surface of the crankshaft axis.

2. Attach the flywheel.

3. Wipe off the oil on the surface of the crankshaft axis.

5.5.1.8 Attentions for Attaching the Mechlock

CAUTION

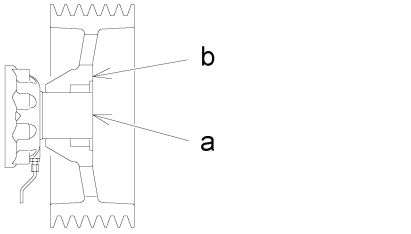
- **Do not use the grease containing molybdenum disulfide and the oil containing extreme-pressure agent when attaching the mechlock.**
- **Always wipe off the grease and foreign materials on the surface of the crankshaft axis and the joint surface of the flywheel before attaching the mechlock.**

1. Align the end surface of the crankshaft axis (a) with the flywheel (b).

2. Tighten the mechlock screws using a torque wrench.

Specified torque: 78.5 N•m

1) Tighten the mechlock screws in the diagonal order to approx. quarter torque of the specified torque.



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2) Tighten the mechlock screws in the diagonal order to approx. half torque of the specified torque.

3) Tighten the mechlock screws in the circumferential order to the specified torque.

5.5.1.9 Attentions for Attaching the Motor Rotor

1. Tighten the motor rotor, and completely fix it with the set bolts.

2. Measure the gap between the motor rotor and the motor cage with the thickness gauge.
Confirm that the gap is 0.6 mm or more at 4 positions or more on the upper/lower and right/left.

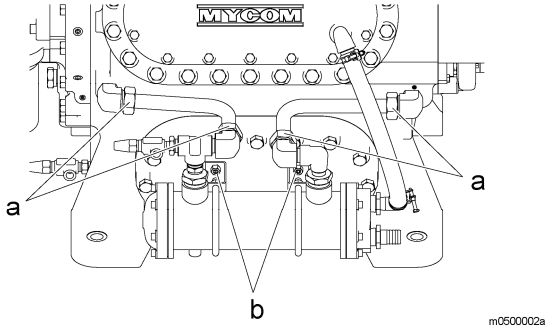
3. When the flange motor or the crankshaft is replaced, temporarily attach the motor rotor, apply the dial gauge to the rotor outer diameter, and check for deviation of the outer diameter while slowly rotating the rotor motor before attaching the motor cage.
Confirm that the deviation is 0.06 mm or less.

5.5.1.10 Attentions for Attaching the Oil Cooler Piping/Water Cooled Type Oil Cooler

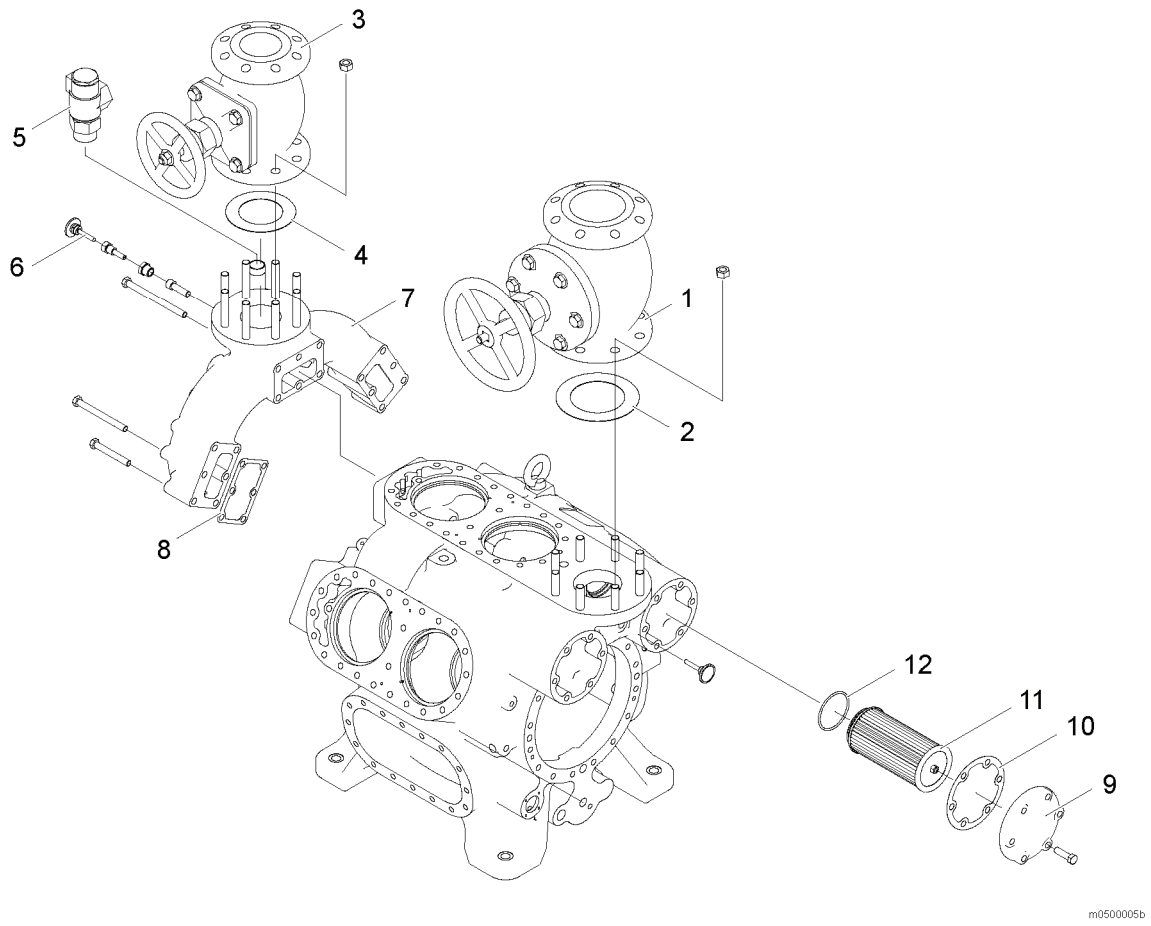
1. Attach the water cooled type oil cooler, and temporarily tighten the tightening nuts (b) of the cooler.

2. Attach the oil cooler piping.

3. Fully tighten the tightening nuts (b) of the water cooled type oil cooler.



5.5.2 Suction/Discharge Area



Steps	Description	Part No.
1	Shut–off valve, suction side (Refer to "Attentions for Removing the Suction/Discharge Shut–off Valve".) (Refer to "Attentions for Attaching the Suction/Discharge Shut–off Valve".)	173
2	Gasket, shut-off valve, suction flange	174
3	Shut–off valve, discharge side (Refer to "Attentions for Removing the Suction/Discharge Shut–off Valve".) (Refer to "Attentions for Attaching the Suction/Discharge Shut–off Valve".)	182
4	Gasket, shut-off valve, discharge flange	183
5	Safety valve	213

Steps	Description	Part No.
6	Thermometer, discharge side	198
7	Discharge manifold (Refer to "Attentions for Removing the Discharge Manifolds".) (Refer to "Attentions for Attaching the Discharge Manifolds".)	168
8	Gasket, discharge manifold	169
9	Suction filter cover	161
10	Gasket, suction filter cover	162
11	Suction filter	154
12	"O"ring, suction filter	154-1
13	Thermometer, Suction side	200

1. Remove the parts in the order shown in the figure.

2. Attach the parts in the reverse order of removal.

5.5.2.1 Attentions for Removing the Suction/Discharge Shut–off Valve

CAUTION

- **The suction/discharge shut–off valve weighs 46 kg/31 kg. Handling them inappropriately may cause injury. Remove the suction/discharge shut–off valve in an appropriate manner with at least one other person.**

5.5.2.2 Attentions for Attaching the Suction/Discharge Shut–off Valve

CAUTION

- **The suction/discharge shut–off valve weighs 46 kg/31 kg. Handling them inappropriately may cause injury. Attach the suction/discharge shut–off valve in an appropriate manner with at least one other person.**

5.5.2.3 Attentions for Removing the Discharge Manifolds

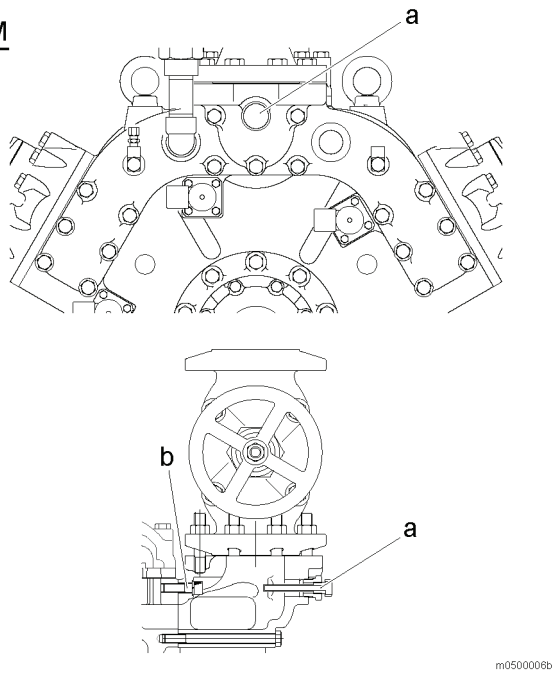
CAUTION

- **The discharge manifolds weigh 73 kg (8M/62M)/62 kg (6M)/50 kg (4M). Handling them inappropriately may cause injury. Remove the discharge manifolds in an appropriate manner with at least one other person.**

【POINT】

- For 6M, the discharge manifold hexagon head screw (b) is attached also to the back of the discharge side thermometer (a) attachment hole.

6M



5.5.2.4 Attentions for Attaching the Discharge Manifolds

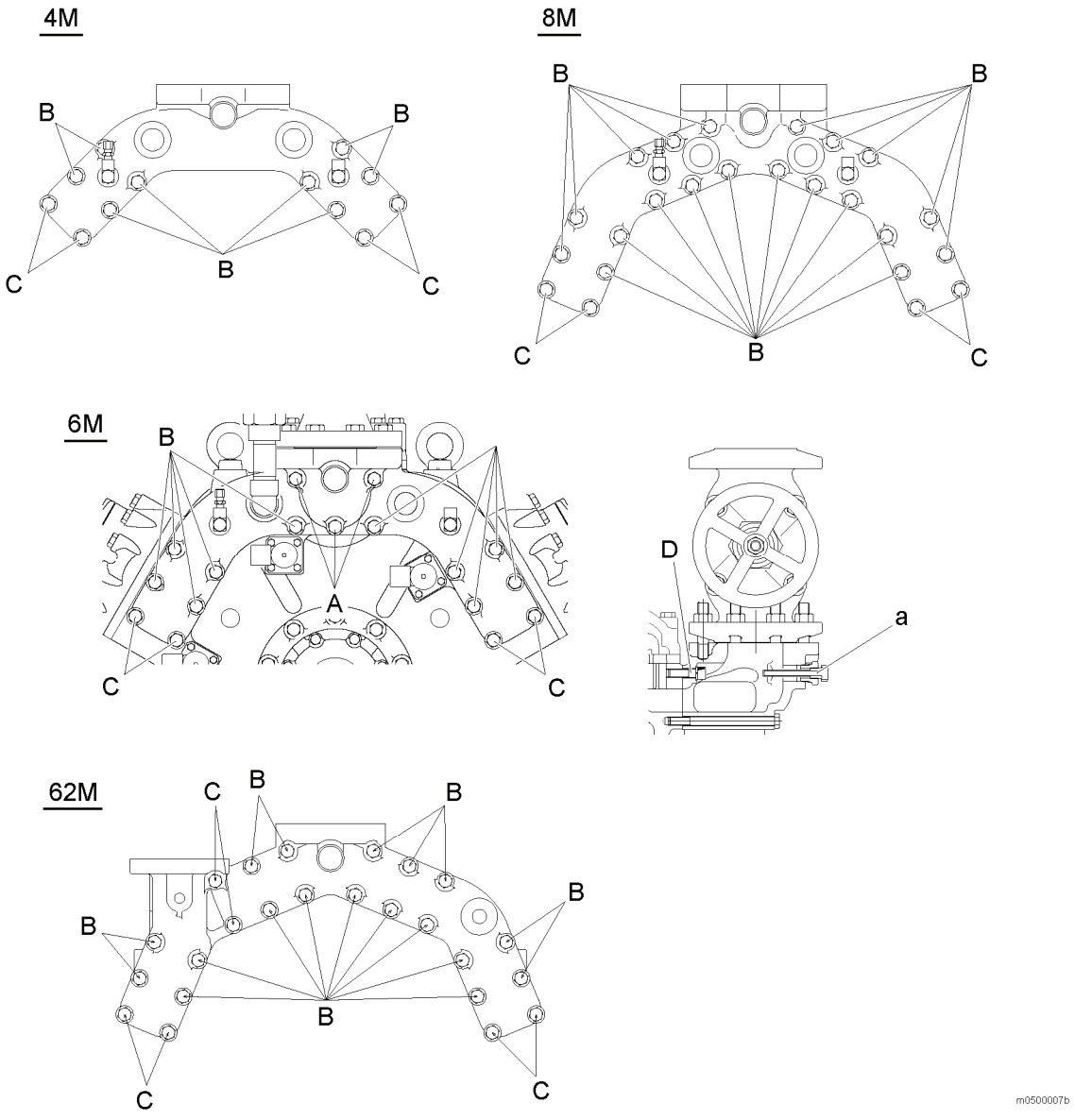
CAUTION

- **The discharge manifolds weigh 73 kg (8M/62M)/62 kg (6M)/50 kg (4M). Handling them inappropriately may cause injury. Attach the discharge manifolds in an appropriate manner with at least one other person.**

1. There are four types of the discharge manifold hexagon head screw. The attachment positions for each type are as shown in the figure.

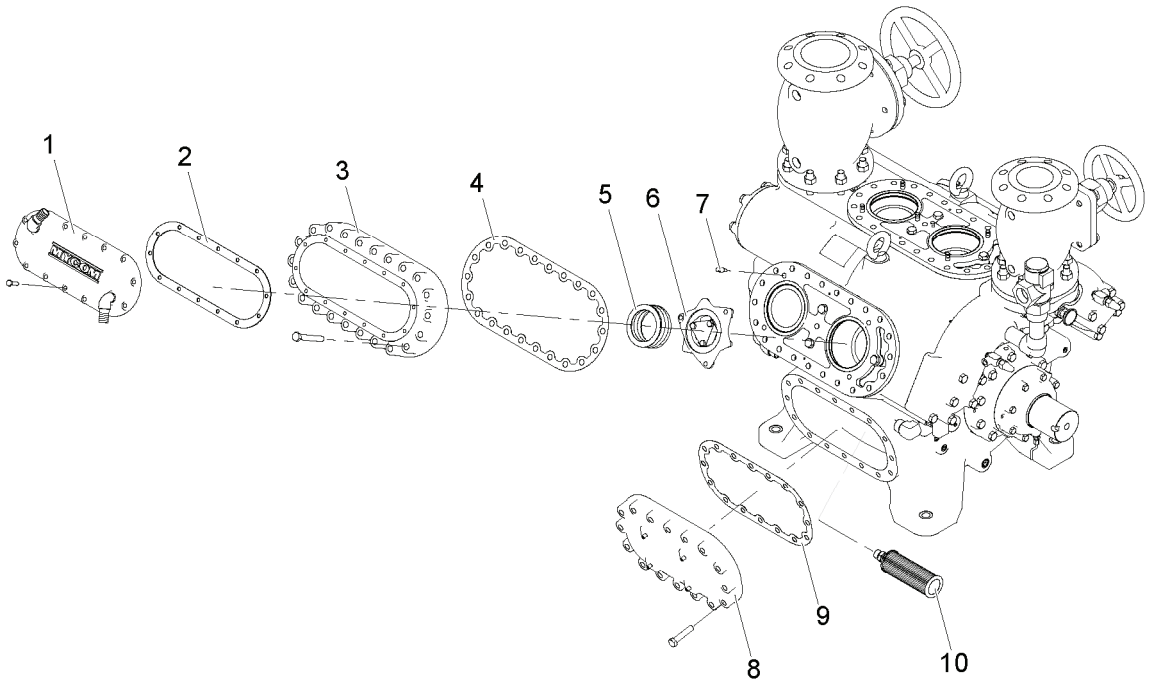
【POINT】

- For 6M, attach the discharge manifold hexagon head screw D by passing it through the discharge side thermometer (a) attachment hole.



Symbol	Description	Size	Quantity		
			4M	6M	8M
A	Hexagon head bolt (No.1), discharge manifold	M16×L200	0	3	0
B	Hexagon head bolt (No.2), discharge manifold	M16×L170	8	10	20
C	Hexagon head bolt (No.3), discharge manifold	M16×L120	4	4	4
D	Hexagon socket head cap screw (No.4), discharge manifold	M16×L55 (hexagon socket set screw)	0	1	0

5.5.3 Head Cover/Hand Hole Cover



Steps	Description	Part No.
1	Head jacket cover (Refer to "Attentions for Removing the Head Jacket Cover/Hand Hole Cover".) (Refer to "Attentions for Attaching the Head Jacket Cover/Hand Hole Cover".)	53
2	Gasket, head jacket cover	55
3	Head cover (Refer to "Attentions for Removing the Head Cover".) (Refer to "Attentions for Attaching the Head Cover".)	50 or 49
4	Gasket, head cover	51
5	Spring, safety head	117

Steps	Description	Part No.
6	Discharge valve cage assembly (Refer to "Discharge Valve Cage Assembly".)	—
7	Stud bolt, discharge valve cage	75-2
8	Hand hole cover (Refer to "Attentions for Removing the Jacket Cover/Hand Hole Cover".) (Refer to "Attentions for Attaching the Jacket Cover/Hand Hole Cover".)	46
9	Gasket, hand hole cover	47
10	Oil strainer	119

1. Remove the parts in the order shown in the figure.

2. Attach the parts in the reverse order of removal.

5.5.3.1 Attentions for Removing the Head Jacket Cover

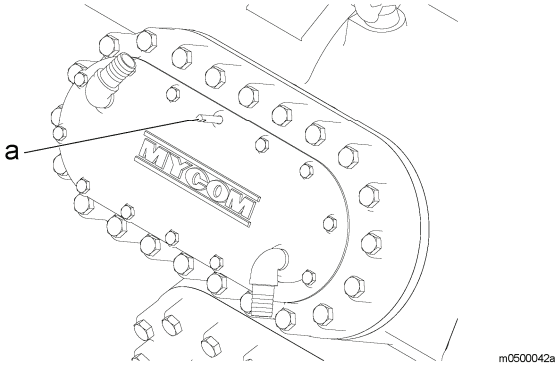
⚠ CAUTION

- **Dropping of the head jacket cover may cause injury or damage to the compressor. Always attach the stud bolts before performing the work.**

【POINT】

- To remove the firmly–retained head jacket cover, tap the cover lightly using a copper hammer or plastic hammer.

1. Remove one of the head jacket cover hexagon head screws from the top, and attach the stud bolt (a).



5.5.3.2 Attentions for Removing the Head Cover

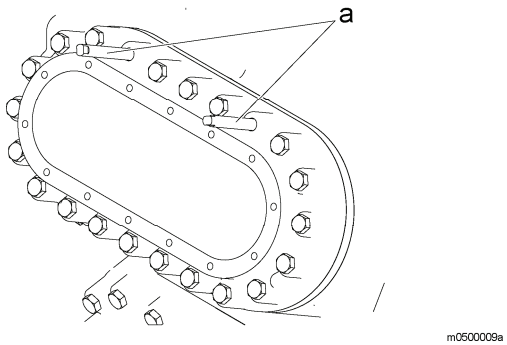
⚠ CAUTION

- **The head cover weighs 31 kg. Handling it inappropriately may cause injury. Remove the head cover in an appropriate manner with at least one other person.**
- **Dropping of the head cover may cause injury or damage to the compressor. Always attach the stud bolts before performing the work.**
- **At the removal of the head cover, the cover may jump off due to the head spring force, resulting in injury. Always remove the head cover according to the following procedure.**

【POINT】

- To remove the firmly–retained head cover, tap the cover using a copper hammer or plastic hammer.

1. Remove the two head cover screws from the top, and attach the stud bolts (a).

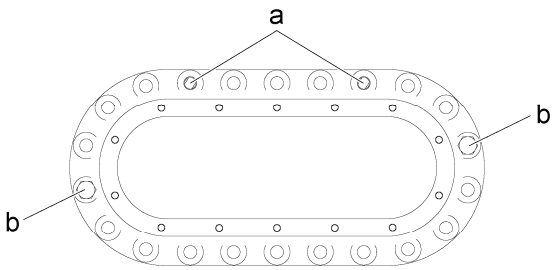


2. Remove the head cover screws while remaining two screws (b) diagonally as shown in the figure.

3. Loosen the screws (b), at the diagonal positions shown in the figure, evenly to remove them.

【POINT】

- After removing the valve plate, remove the stud bolts (a).



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5.5.3.3 Attentions for Removing the Hand Hole Cover

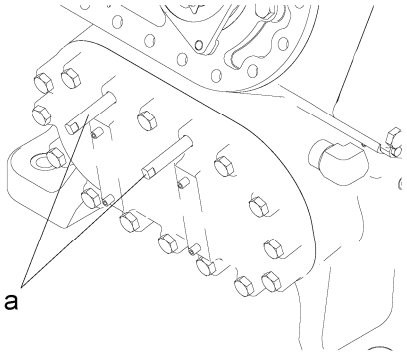
⚠ CAUTION

- **Dropping of the hand hole cover may cause injury or damage to the compressor. Always attach the stud bolts before performing the work.**
- **Because the attachment surface of the hand hole cover is facing obliquely downward, the cover may fall even when the stud bolts are used. Be careful so as not to place any part of your body under the hand hole cover.**

【POINT】

- To remove the firmly–retained hand hole cover, tap the cover using a copper hammer or plastic hammer.

1. Remove the two hand hole cover screws from the top, and attach the stud bolts (a).



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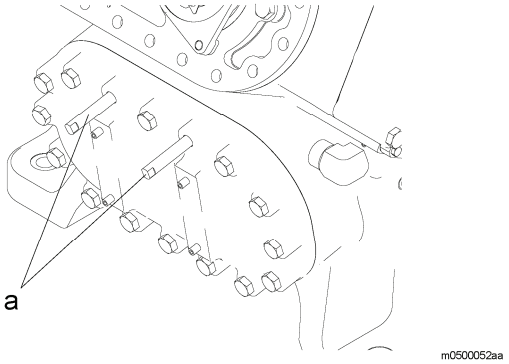
5.5.3.4 Attentions for Attaching the Hand Hole Cover

CAUTION

- **Dropping of the hand hole cover may cause injury or damage to the compressor. Always attach the stud bolts before performing the work.**
- **Because the attachment surface of the hand hole cover is facing obliquely downward, the cover may fall even when the stud bolts are used. Be careful so as not to place any part of your body under the hand hole cover.**

1. After attaching the stud bolts (a) into the hand hole cover screw holes for two sections at the top, attach the hand hole cover.

2. After temporarily tightening the rest of the hand hole cover screws, remove the stud bolts.



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5.5.3.5 Attentions for Attaching the Head Cover

CAUTION

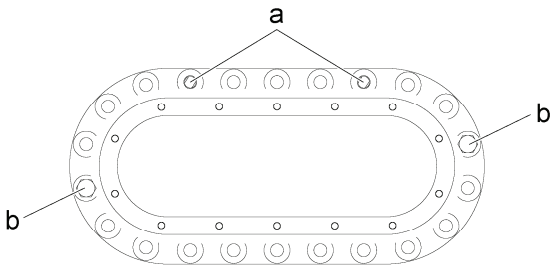
- **The head cover weighs 31 kg. Handling it inappropriately may cause injury. Attach the head cover in an appropriate manner with at least one other person.**
- **Dropping of the head cover may cause injury or damage to the compressor. Always attach the stud bolts before performing the work.**
- **Always attach the head cover according the following procedure.**

【POINT】

- If the stud bolts that are used for attaching the valve plate are already removed, attach the stud bolts (a) into the head cover screw holes for two sections at the top, then attach the head cover.

1. Attach the two head cover screws (b) to the diagonal sections shown in the figure, and tighten them temporarily and evenly.

2. Temporarily tighten the rest of the head cover screws, then remove the stud bolts (a).



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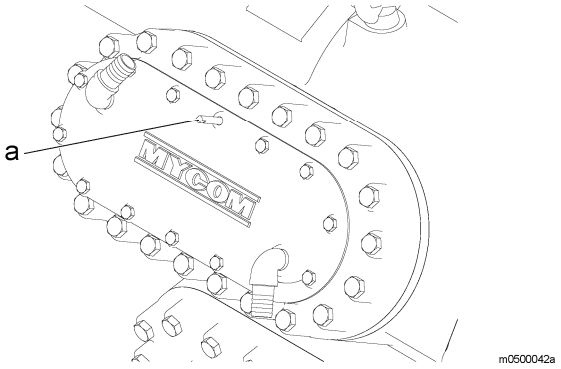
5.5.3.6 Attentions for Attaching the Head Jacket Cover

CAUTION

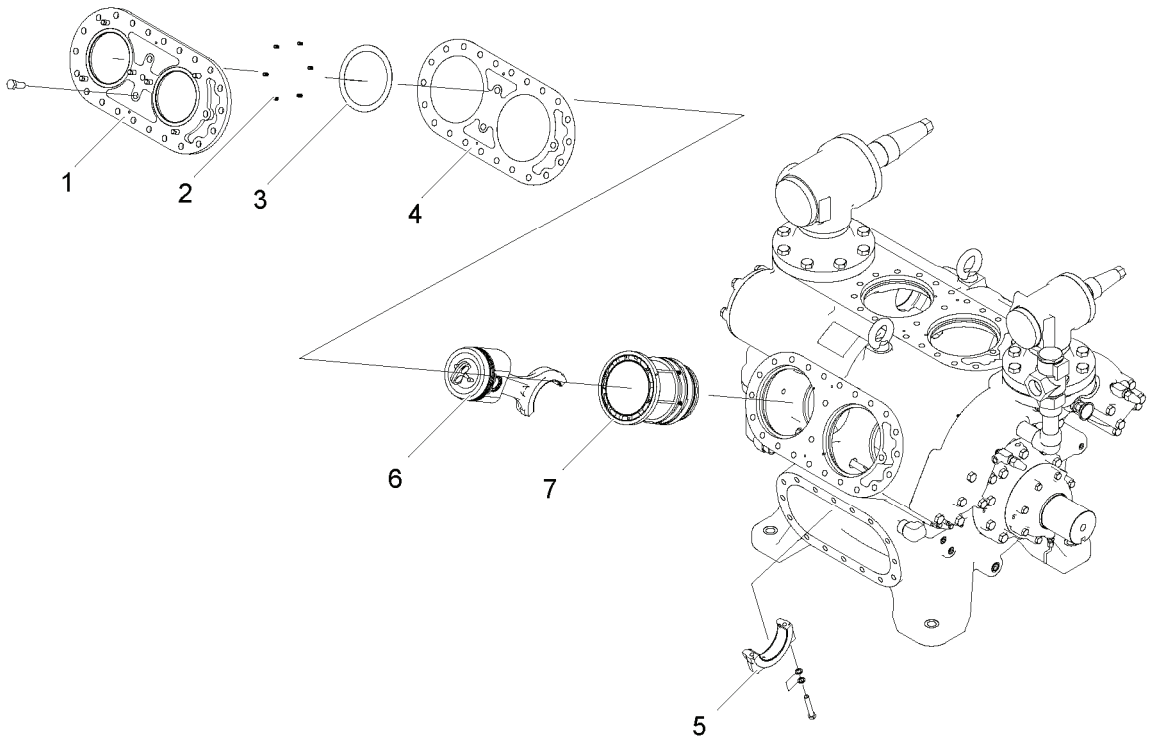
- **Dropping of the head jacket cover may cause injury or damage to the compressor. Always attach the stud bolts before performing the work.**

1. After attaching the stud bolt (a) into the head jacket cover hexagon head screw hole for one section at the top, attach the head jacket cover.

2. After temporarily tightening the rest of the head jacket cover hexagon head screws, remove the stud bolt.



5.5.4 Valve Plate/Piston Assembly/Cylinder Sleeve Assembly



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Steps	Description	Part No.
1	Valve plate (Refer to "Attentions for Removing the Valve Plate".) (Refer to "Attentions for Attaching the Valve Plate".)	73
2	Spring, suction valve (Refer to "Attentions for Attaching the Suction Plate Valve/Suction Valve Spring".)	72
3	Suction plate valve	71
4	Gasket, valve plate	73-4

Steps	Description	Part No.
5	Connecting rod (rod cap) (Refer to "Attentions for Removing the Piston Assembly".) (Refer to "Attentions for Attaching the Piston Assembly".)	77-S or 77-L
6	Piston assembly & connecting rod (rod) (Refer to "Attentions for Removing the Piston Assembly".) (Refer to "Attentions for Attaching the Piston Assembly".) (Refer to "Piston Assembly".)	77-S or 77-L
7	Cylinder Sleeve Assembly (Refer to "Attentions for Attaching the Cylinder Sleeve Assembly".) (Refer to "Cylinder Sleeve Assembly".)	—

【POINT】

- For the attachment of the valve plate and cylinder sleeve, insert a spacer between the unloader piston and unloader cover. The valve plate and cylinder sleeve cannot be attached unless a spacer is inserted between them.

1. Insert a spacer with thickness of 17—19 mm between the unloader piston and unloader cover. (Refer to "Attachment of the Spacer".)

2. Remove the parts in the order shown in the figure.

3. Attach the parts in the reverse order of removal.

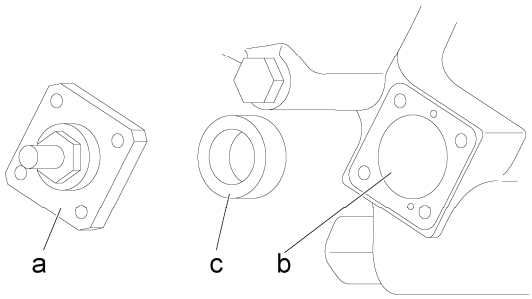
4. Remove the spacer. (Refer to "Removal of the Spacer".)

5.5.4.1 Attachment of the Spacer（4M/6M/8M/62M）

1. Remove the coil screw from the solenoid valve unloader cover integrated to remove the coil.

2. Loosen the unloader cover hexagon head screw, and remove the unloader cover (a).

3. With the spacer with thickness of 17—19 mm inserted between the unloader piston (b) and unloader cover (a), tighten the two unloader cover hexagon head screws manually.



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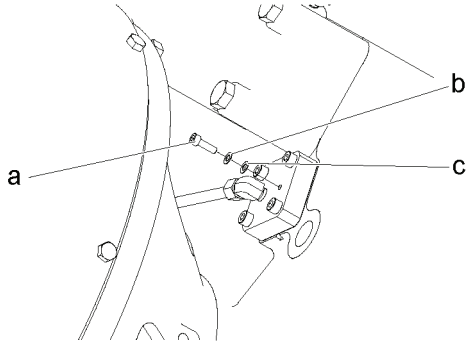
5.5.4.2 Attachment of Knob Bolt (62M-FM）

1. Remove the unloader cover cap screw (a), washer (b), and aluminum washer (c).



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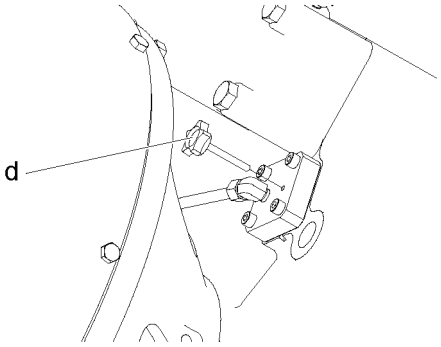
2. Attach the knob bolt (d) and fully screw it in.



m0500063a

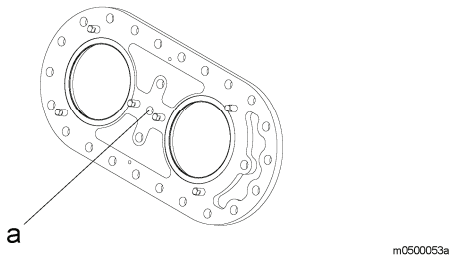
5.5.4.3 Attentions for Removing the Valve Plate

CAUTION

- **Dropping of the valve plate may cause injury or damage to the compressor. Always attach the stud bolts before performing the work.**

【POINT】

- If the stud bolts that are used for removing the head cover are already removed, attach the stud bolts into the head cover screw bolt holes for two sections at the top, then remove the valve plate.
- To remove the firmly–retained valve plate, insert the valve plate screw into the service hole (a) and tighten it.

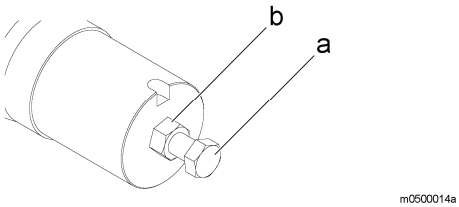


5.5.4.4 Attentions for Removing the Piston Assembly

1. Attach the bolt (M20) (a) and nut (b) to the crankshaft.
Use the set bolts (M27 with fine pitch) for 62M-FM.

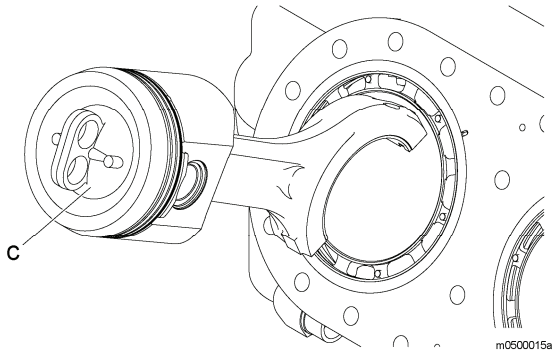
2. Using the bolt (M20) (a), rotate the crankshaft so that the piston assembly to be removed is positioned at the bottom dead center.

3. Remove the piston assembly using the suction disk (c).



CAUTION

- **Verify that the suction disk is firmly stuck to the piston assembly. If the suction disk is not stuck firmly, the piston assembly may fall, resulting in hand or physical injury.**

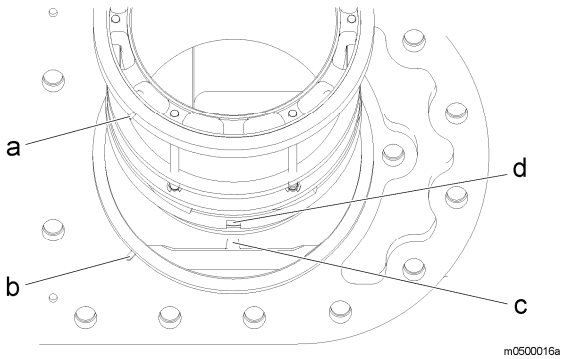


5.5.4.5 Attentions for Attaching the Cylinder Sleeve Assembly

1. Align the sleeve positioning pin (a) with the groove on the case (b).

2. While keeping the pin aligned with the groove, align the unloader push rod tab (c) with the cam ring notch (d).

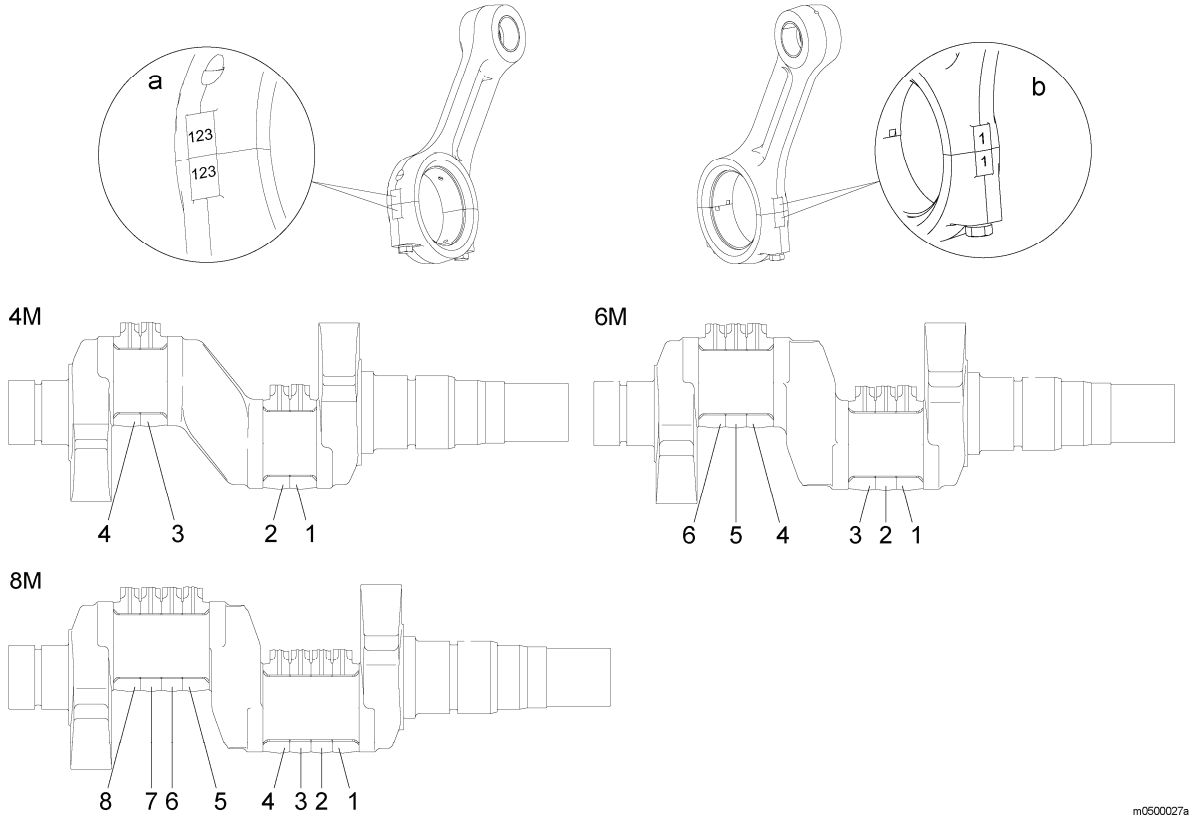
3. To check the attachment condition of the cylinder sleeve assembly, check the movement of the unloader push rod (piston) when removing the spacer used for the unloader maintenance. (Refer to "Removal of the Spacer".)



5.5.4.6 Attentions for Attaching the Piston Assembly

【POINT】

- 3 digit–number (a) is marked on the rod and rod cap of the connecting rod for combination as shown in the figure. Assemble the rod and rod cap of the connecting rod, which have the same number for combination, with the numbers facing the same direction.
- Piston number (b) is marked onto the opposite position of the number for combination on the rod of the connecting rod as shown in the figure. Attach the piston to the cylinder with the same number.
- When attaching the following connecting rods to the crankshaft, be careful of their direction: 4 M connecting rod, 6M connecting rods (No.1/No.3/No.4/No.6), and 8M connecting rods (No.1/No.4/No.5/No.8)



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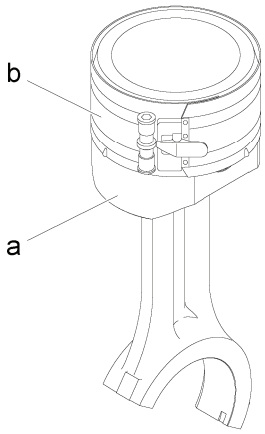
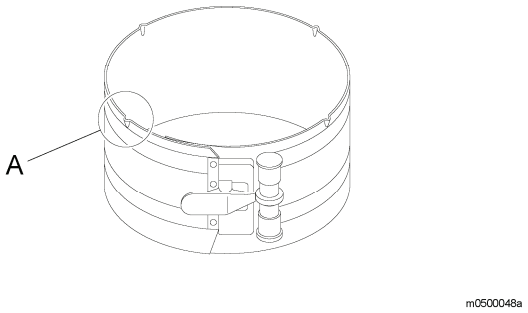
1. Attach the piston ring compressor (b) to the piston assembly (a).



m0500046a

【POINT】

- Face section A of the piston ring compressor shown in the figure towards the piston skirt.



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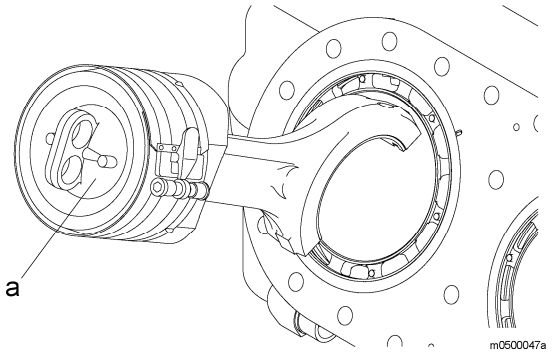
2. Rotate the crankshaft so that the piston assembly to be attached is positioned at the bottom of dead center.

3. Insert the piston assembly into the cylinder sleeve so that it comes to the bottom of the piston using the suction disk (a).

⚠ CAUTION

- **Verify that the suction disk is firmly stuck to the piston assembly. If the suction disk is not stuck firmly, the piston assembly may fall, resulting in hand or physical injury.**



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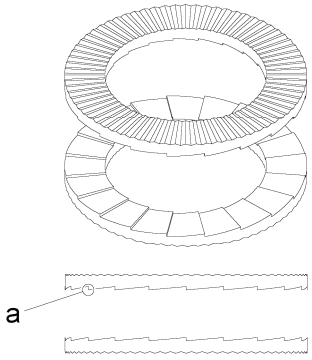
4. While supporting the connecting rod end with your hand through the hand hole and tapping the piston head, insert the piston assembly into the cylinder sleeve.

CAUTION

- **Be careful not to damage the crankshaft by the end of the connecting rod.**

5. Assemble the two connecting rod hexagon head screw washers as shown in the figure.
If the corner (a) of the connecting rod hexagon head screw washer baffle becomes obtuse, replace the washer.



m0500017a

6. Tighten the connecting rod hexagon head screws gradually and evenly.

7. Tighten the connecting rod hexagon head screws using the specified torque.

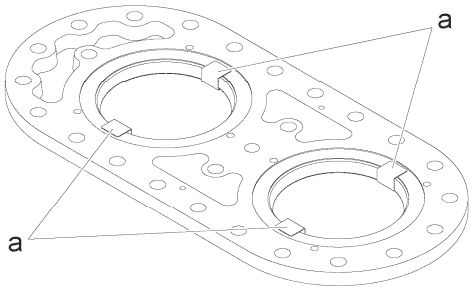
5.5.4.7 Attentions for Attaching the Suction Plate Valve/Suction Valve Spring

1. Retain the suction plate valve and suction valve spring to the valve plate using clips (a).

【POINT】

- Align the suction valve spring (b) with the valve plate (c) in the direction shown in the figure.

2. After attaching the valve plate, remove the clips.



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5.5.4.8 Attentions for Attaching the Valve Plate

⚠ CAUTION

- **Dropping of the valve plate may cause injury or damage to the compressor. Always attach the stud bolts before performing the work.**

1. After attaching the stud bolts into the head cover screw holes for two sections at the top, attach the valve plate.

【POINT】

- After attaching the head cover, remove the stud bolts.

5.5.4.9 Removal of the Spacer (4M/6M/8M/62M)

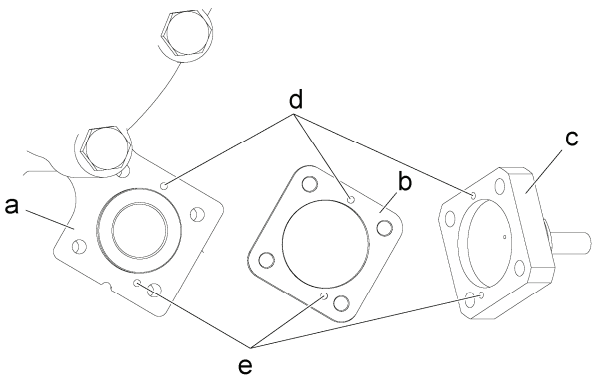
1. Loosen the unloader cover hexagon head screw, and remove the unloader cover.

2. Remove the spacer.

3. Press the unloader piston with your hand to check that the unloader push rod moves.

4. Align the crankcase (a) with the gasket (b), and drain hole (d) of the unloader cover (c) with the filler opening (e), then attach the gasket (b) and unloader cover (c).

5. Attach the coil of the solenoid valve unloader cover integrated.



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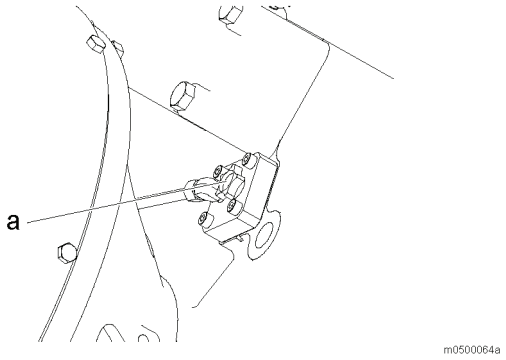
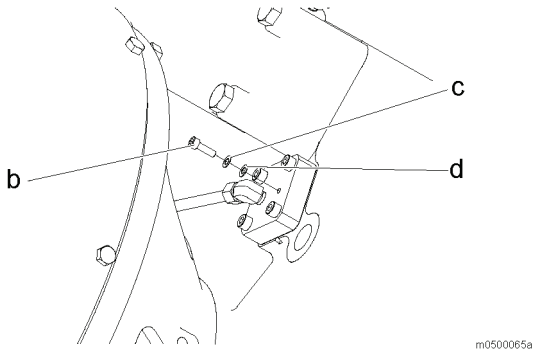
5.5.4.10 Removal of Knob Bolt (62M-FM）

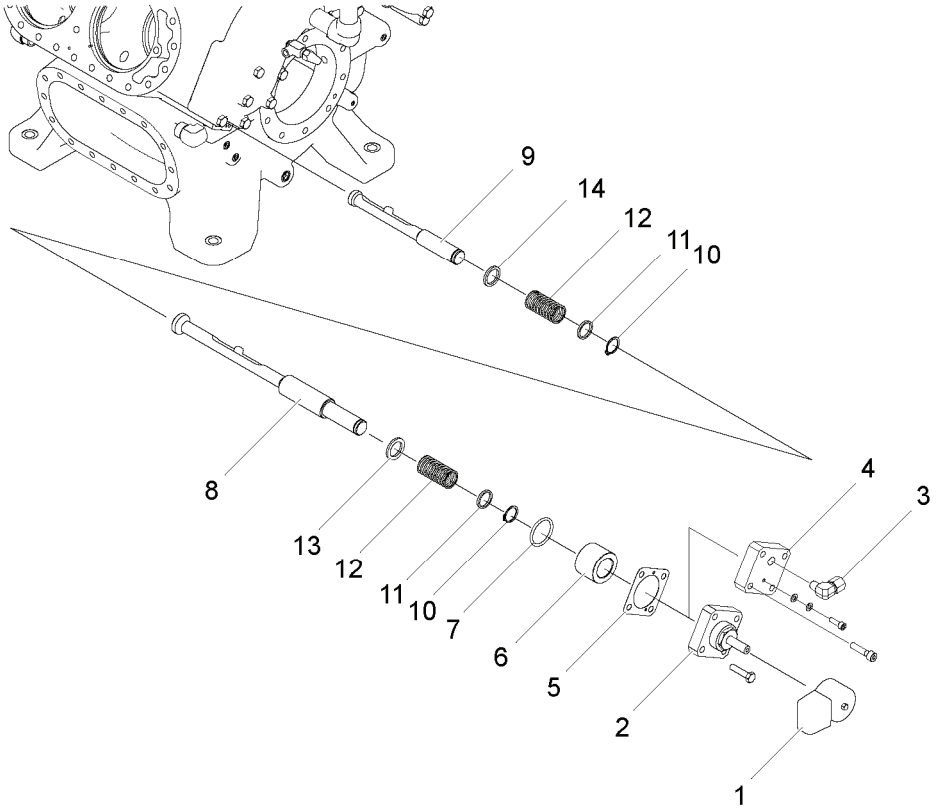
1. Remove the knob bolt (a).



2. Attach the cap screw (b), washer (c), aluminum washer (d) to the unloader cover.



5.5.5 Unloader



Steps	Description	Part No.
1	Coil (solenoid valve unloader cover integrated) (4M/6M/8M)	205
2	Unloader cover (solenoid valve unloader cover integrated) (4M/6M/8M) (Refer to "Attentions for Attaching the Solenoid Valve Unloader Cover Integrated".)	146
3	Connector (62M-FM)	
4	Unloader cover (62M-FM)	
5	Gasket, unloader cover	147
6	Unloader piston	145
7	"O"ring, unloader piston	145-1
8	Unloader push rod (Refer to "Attentions for Attaching the Unloader Push Rod Assembly".)	135

Steps	Description	Part No.
9	Unloader push rod	135
10	Retaining ring, unloader push rod	144
11	Washer (No1), unloader push rod (Refer to "Attentions for Attaching the Unloader Push Rod Washer".)	143
12	Spring, unloader device	142
13	Washer (No2), unloader push rod (Refer to "Attentions for Attaching the Unloader Push Rod Washer".)	143-1
14	Washer (No3), unloader push rod (Refer to "Attentions for Attaching the Unloader Push Rod Washer".)	143-2

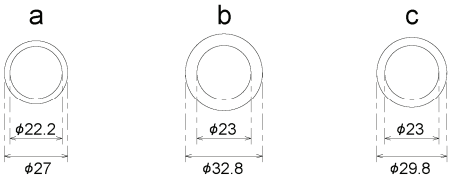
1. Remove the parts in the order shown in the figure.

2. Attach the parts in the reverse order of removal.

5.5.5.1 Attentions for Attaching the Unloader Push Rod Washer

【POINT】

- Unloader push rod washer (No.1) (a), unloader push rod washer (No.2) (b), and unloader push rod washer (No.3) (c) differ as shown in the figure.



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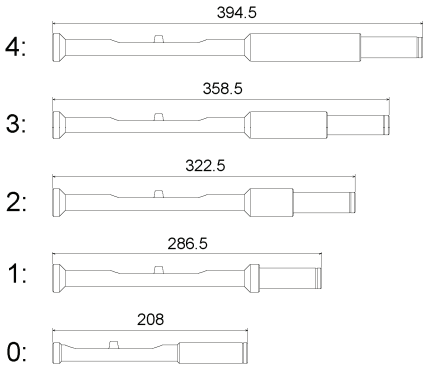
5.5.5.2 Attentions for Attaching the Unloader Push Rod Assembly

1. There are five types of the unloader push rod depending on its length. The attachment positions for each unloader push rod assembly are as shown in the figure.



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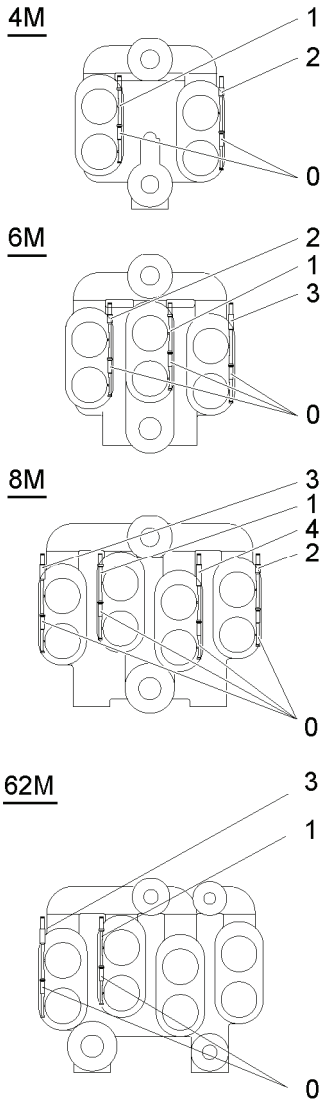

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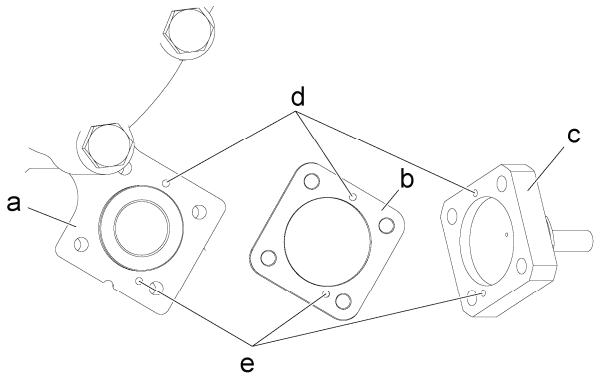
5.5.5.3 Attentions for Attaching the Solenoid Valve Unloader Cover Integrated

1. Align the crankcase (a) with the gasket (b), and drain hole (d) of the unloader cover (c) with the filler opening (e), then attach the gasket (b) and unloader cover (c).



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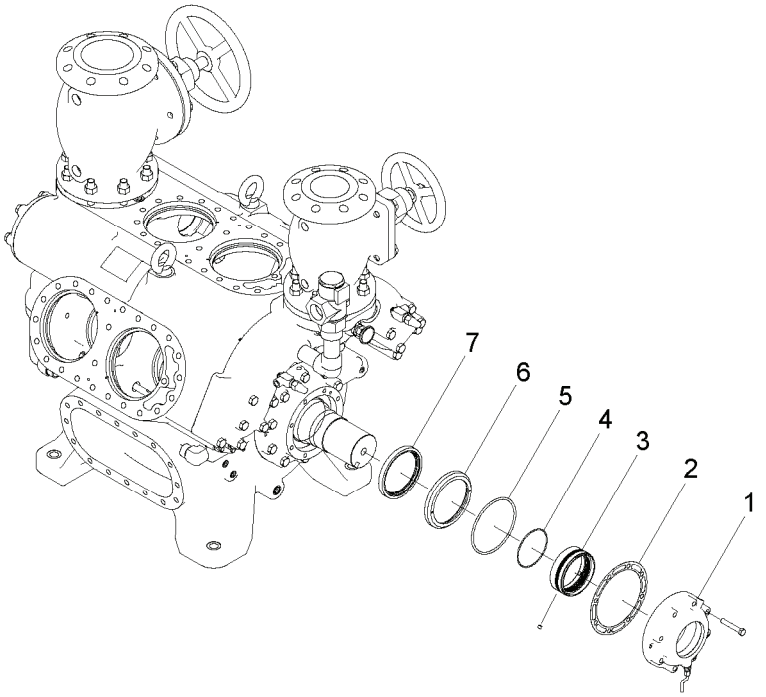
5.5.6 Seal Cover/Mechanical Seal/Oil Seal



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Steps	Description	Part No.
1	Seal cover assembly (Refer to "Attentions for Removing the Seal Cover Assembly".) (Refer to "Attentions for Attaching the Seal Cover Assembly".) (Refer to "Disassembly/Assembly of the Seal Cover".)	26
2	Gasket, shaft seal cover	27
3	Mechanical seal collar (Refer to "Attentions for Attaching the Mechanical Seal collar".)	32

Steps	Description	Part No.
4	"O"ring, mechanical seal collar	39
5	"O"ring, oil seal retainer	37
6	Retainer, oil seal (Refer to "Attentions for Removing the Oil Seal Retainers".)	34
7	Oil seal (Refer to "Attentions for Removing the Oil Seal".) (Refer to "Attentions for Attaching the Oil Seal".)	35

1. Remove the parts in the order shown in the figure.

2. Attach the parts in the reverse order of removal.

5.5.6.1 Attentions for Removing the Seal Cover Assembly

CAUTION

- **Dropping of the seal cover assembly may cause injury or damage to the compressor. Always attach the stud bolts before performing the work.**
- **Be careful not to damage the mechanical seal collar.**

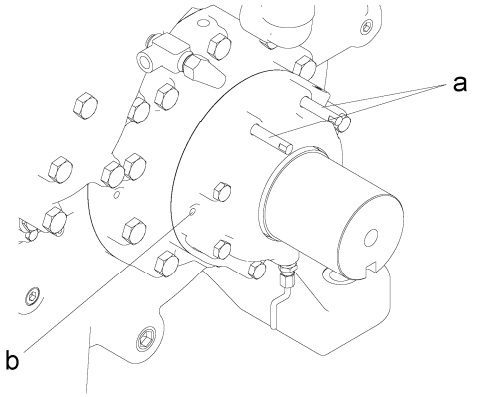
【POINT】

- To remove the firmly–retained seal cover assembly, insert the seal cover assembly screws into the service holes (b) and tighten them. (There are two holes diagonally.)

1. Remove the two seal cover assembly screws from the two sections at the top, and attach the stud bolts (a).

2. Loosen the rest of the seal cover assembly screws.

3. Remove the seal cover while being careful not to damage the mechanical seal collar.



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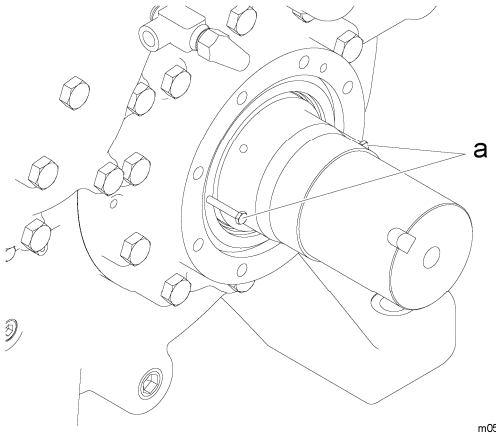
5.5.6.2 Attentions for Removing the Oil Seal Retainers

1. Attach the two bolts (M6) (b) into the screw holes on the oil seal retainers (a).

2. Pull the bolts (M6) (b) to remove the oil seal retainers (a).



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5.5.6.3 Attentions for Removing the Oil Seal

1. Attach the two bolts (M6) into the screw holes on the oil seal retainers.

2. Tighten the bolts (M6) alternately and evenly, then separate the oil seal retainers and oil seal.

5.5.6.4 Attentions for Attaching the Oil Seal

1. Drive the oil seal parallel to the oil seal retainers.

5.5.6.5 Attentions for Attaching the Mechanical Seal Collar

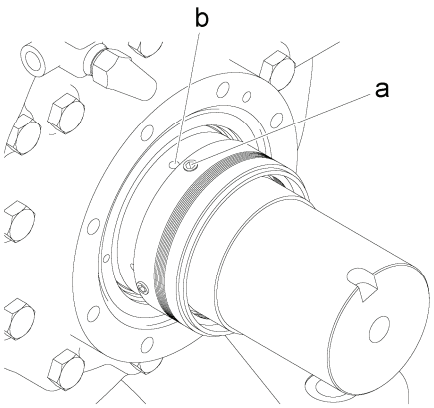
1. Position the mechanical seal collar set screw (a) to the front (collinear position) of the set screw hole (b) on the crankshaft.

2. Lightly tighten the set screws (a) at the two sections of the mechanical seal collar, and slightly loosen them when the screws contact the crankshaft.

3. Press in the mechanical seal collar without rotating it.

4. Lightly tighten the set screws (a) at two sections on the mechanical seal collar to check that the seal rotates (aligned with the hole).

5. Tighten the set screws (a) at two sections on the mechanical seal collar.



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5.5.6.6 Attentions for Attaching the Seal Cover Assembly

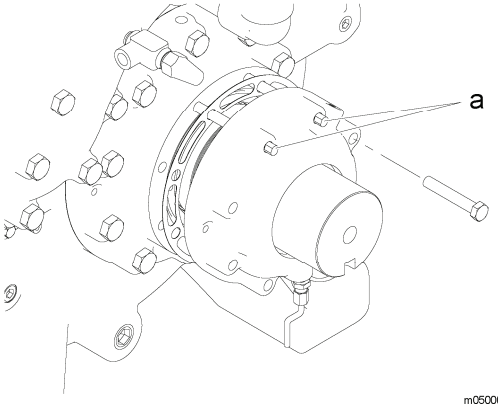
⚠ CAUTION

- **Dropping of the seal cover assembly may cause injury or damage to the compressor. Always attach the stud bolts before performing the work.**
- **Be careful not to damage the mechanical seal collar.**

1. Attach the stud bolts into the stud bolt screw holes for two sections at the top.

2. Attach the seal cover while being careful not to damage the mechanical seal collar.

3. After temporarily tightening the rest of the seal cover assembly screws, remove the stud bolts.



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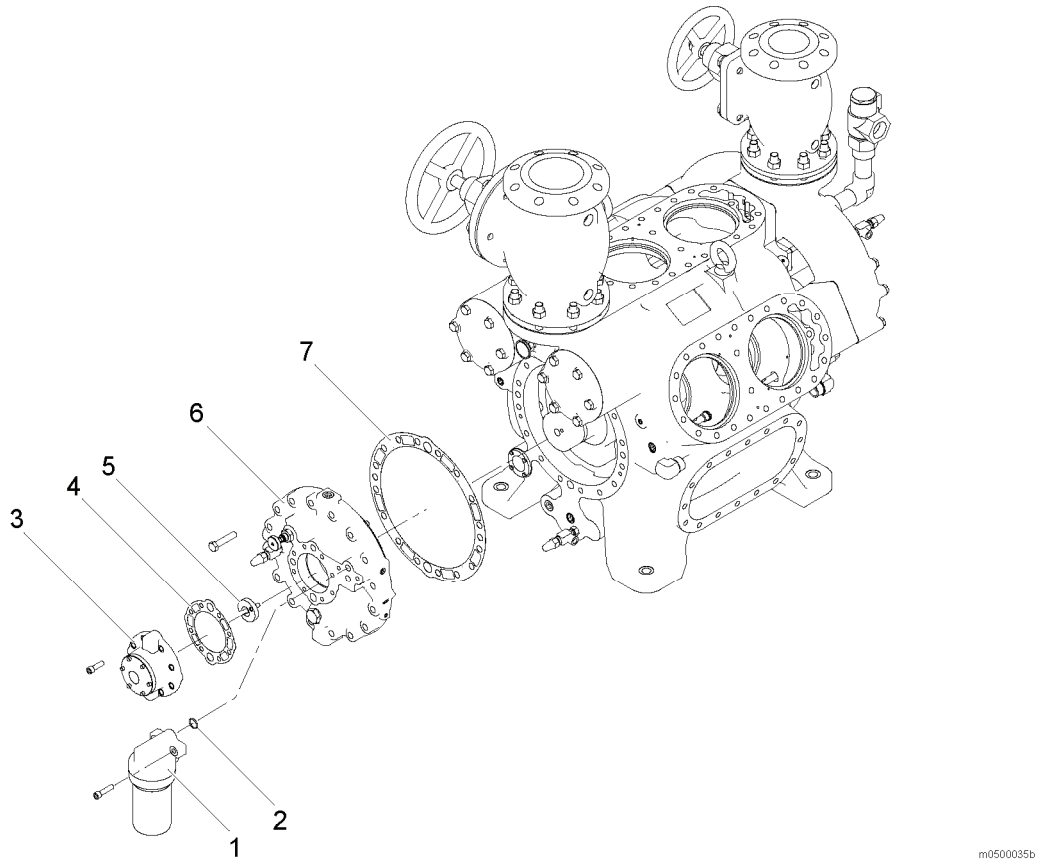
5.5.7 Main Bearing Head Assembly/Oil Pump Assembly/Oil Filter Assembly



Steps	Description	Part No.
1	Oil filter assembly (Refer to "Oil Filter Assembly".)	14
2	"O"ring, oil filter head	15
3	Oil pump assembly	56
4	Gasket, oil pump	59
5	Drag crank	3

Steps	Description	Part No.
6	Main bearing head assembly (Refer to "Attentions for Removing the Main Bearing Head Assembly".) (Refer to "Attentions for Attaching the Main Bearing Head Assembly".)	—
7	Gasket, main bearing head (Refer to "Attentions for Attaching the Main Bearing Head Gasket".)	9

1. Remove the parts in the order shown in the figure.

2. Attach the parts in the reverse order of removal.

5.5.7.1 Attentions for Removing the Main Bearing Head Assembly

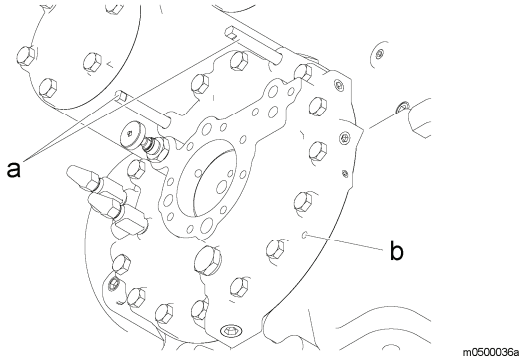
CAUTION

- **The main bearing head assembly weighs 50 kg. Handling it inappropriately may cause injury. Remove the main bearing head assembly in an appropriate manner with at least one other person.**
- **Dropping of the main bearing head assembly may cause injury or damage to the compressor. Always attach the stud bolts before performing the work.**

【POINT】

- To remove the firmly–retained main bearing head assembly, insert the main bearing head assembly screws into the service holes and tighten them. (There are two holes diagonally.)

1. Remove the two main bearing head screws from the top, and attach the stud bolts (a).



5.5.7.2 Attentions for Attaching the Main Bearing Head Gasket

1. Align the screw and oil holes on the main bearing head gasket with those on the crankcase.

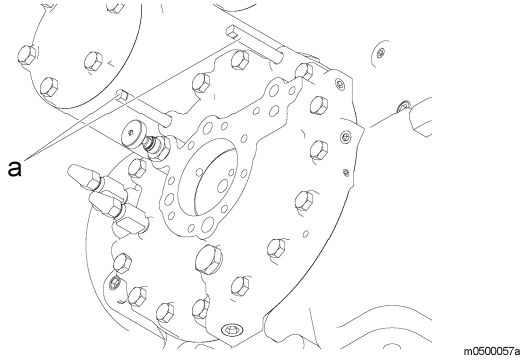
5.5.7.3 Attentions for Attaching the Main Bearing Head Assembly

CAUTION

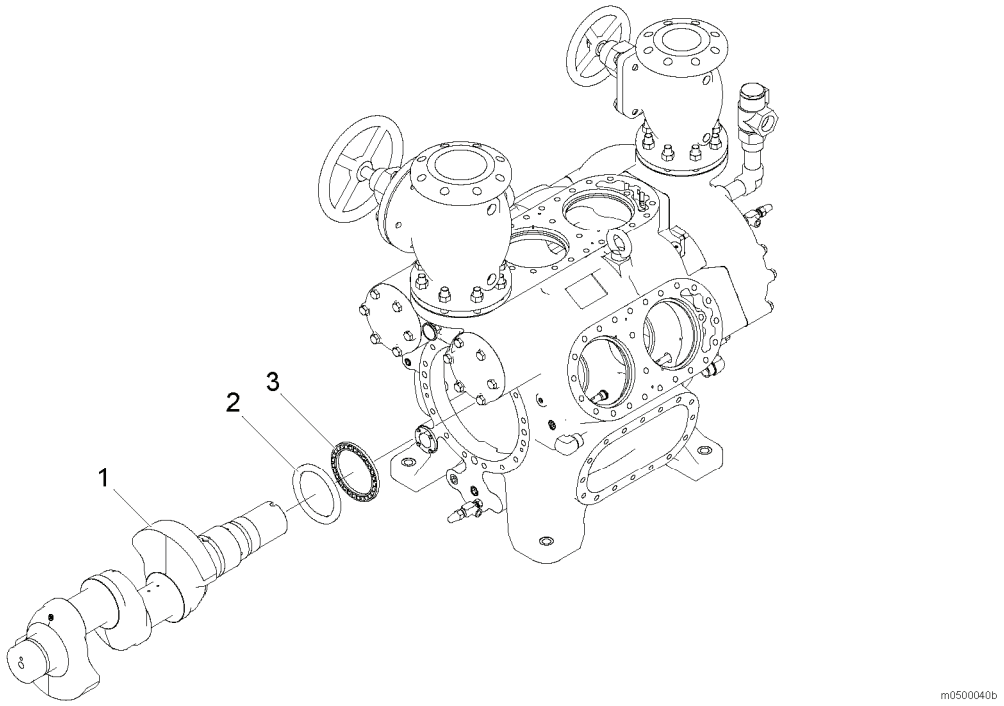
- **The main bearing head assembly weighs 50 kg. Handling it inappropriately may cause injury. Attach the main bearing head assembly in an appropriate manner with at least one other person.**
- **Dropping of the main bearing head assembly may cause injury or damage to the compressor. Always attach the stud bolts before performing the work.**

1. Attach the stud bolts, and then attach the main bearing head.

2. After temporarily tightening the main bearing head hexagon head screws, remove the stud bolts.



5.5.8 Crankshaft



Steps	Description	Part No.
1	Crankshaft (Refer to "Attentions for Removing the Crankshaft".) (Refer to "Attentions for Attaching the Crankshaft".)	2

Steps	Description	Part No.
2	Thrust roller bearing (shaft side) (Refer to "Attentions for Attaching the Thrust Roller Bearing (Shaft Side)".)	29-1
3	Thrust roller bearing (roller)	29-1

1. Remove the parts in the order shown in the figure.

2. Attach the parts in the reverse order of removal.

5.5.8.1 Attentions for Removing the Crankshaft

CAUTION

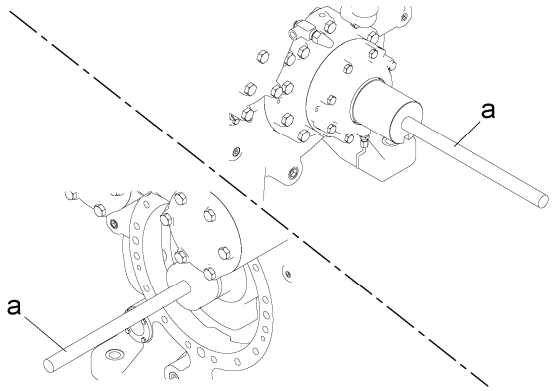
- **The crankshaft weighs approx. 140 kg. Handling it inappropriately may cause injury. Remove the crankshaft in an appropriate manner with at least two other people.**

1. Affix curing tape onto the attachment surface of the crankshaft flywheel so that it is not scratched.

2. Attach the coupling rods (a) (or M20 bolts with a sufficient length) into the screw holes at both ends of the crankshaft axis.

【POINT】

- Use the bolts (M27 with fine pitch) on the seal cover for 62M-FM.



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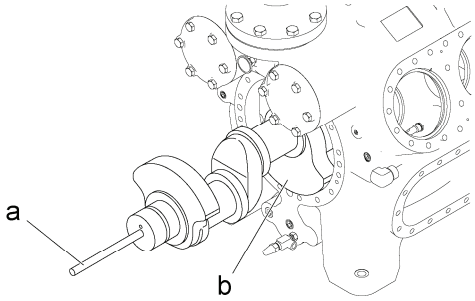
3. Rotate the crankshaft so that the crankshaft balancer at the seal cover side is positioned at the bottom.

4. Lift the crankshaft by holding the coupling rods (a) (or bolts with a sufficient length) that are attached in Step 2.

5. Pull out the crankshaft until the crankshaft balance weight (b) at the seal cover side comes to the position of the main bearing head assembly attachment flange on the crankcase.

6. Lower the crankshaft so that the crankshaft balance weight (b) at the seal cover side is properly placed onto the main bearing head assembly attachment flange on the crankcase.



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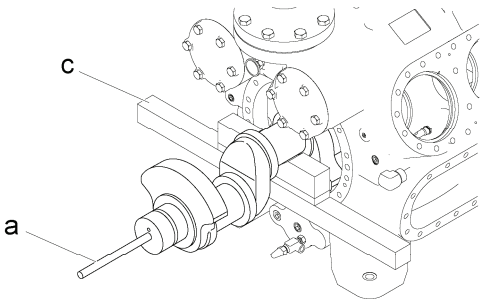
7. Lift the crankshaft to pull it out from the crankcase by holding the coupling rods (a) (or bolts with a sufficient length) that are attached in Step 2 and the block (c).

【POINT】

- Support the bearing axis of the removed crankshaft using a V-shaped wooden block so that it is not scratched.



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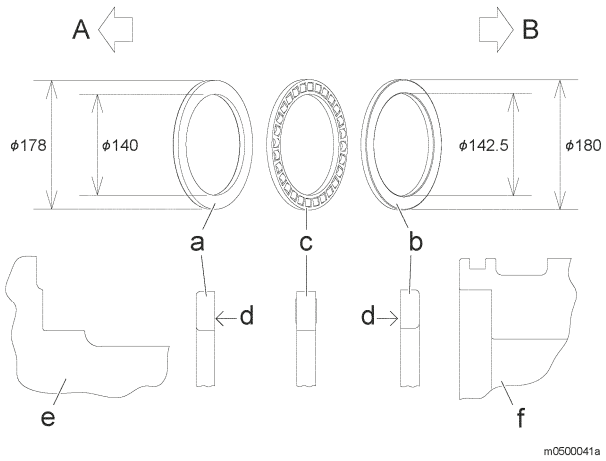
5.5.8.2 Attentions for Attaching the Thrust Roller Bearing (Shaft Side)

1. Attach the thrust roller bearing (shaft side) (a) and thrust roller bearing (bearing head side) (b) to the correct positions.

2. Face a flat surface (d) of the thrust roller bearing (shaft side) (a) towards the thrust roller bearing (roller) (c).



Symbol	Description
A	Shaft side
B	Bearing head side
e	Shaft
f	Case

5.5.8.3 Attentions for Attaching the Crankshaft

CAUTION

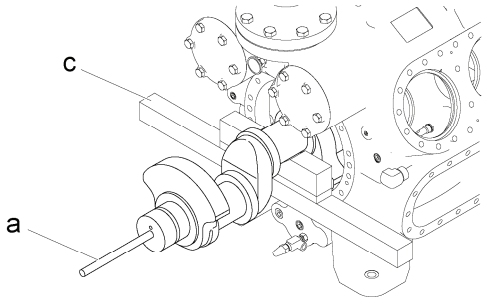
- **The crankshaft weighs approx. 140 kg. Handling it inappropriately may cause injury. Attach the crankshaft in an appropriate manner with at least two other people.**

1. Attach the coupling rod (a) (or an M20 bolt with a sufficient length) into the screw hole at the end of the crankshaft axis at the main bearing head side.

【POINT】

- Use the bolts (M27 with fine pitch) on the seal cover for 62M-FM.

2. Lift the crankshaft by holding the coupling rod (a) (or the bolt with a sufficient length) that is attached in Step 1 and a block (c) until the crankshaft balance weight at the seal cover side comes to the position of the main bearing head assembly attachment flange on the crankcase.



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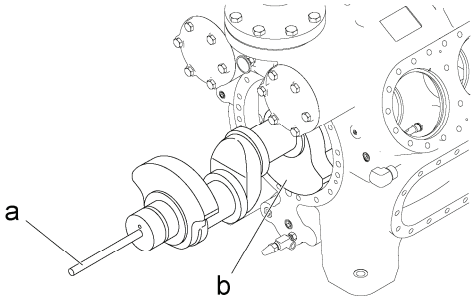
3. Lower the crankshaft so that the crankshaft balance weight (b) at the seal cover side is properly placed onto the main bearing head assembly attachment flange on the crankcase.



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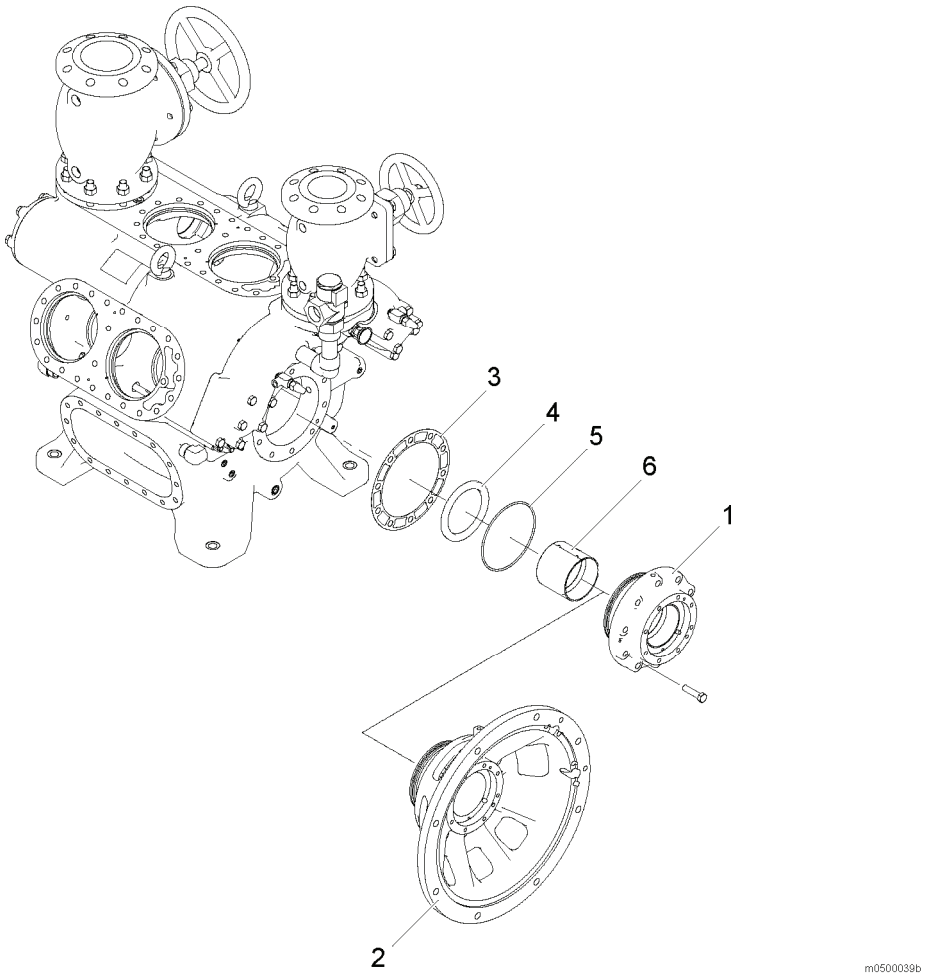
4. Attach the coupling rod (or a bolt with a sufficient length) into the screw hole at the end of the crankshaft axis at the seal cover side.

5. Lift the crankshaft to attach it to the specified position using the coupling rods (or bolts with a sufficient length) that are attached in Steps 1 and 4.

5.5.9 Bearing Head



Steps	Description	Part No.
1	Bearing head (4M/6M/8M/62M) (Refer to "Attentions for Removing the Bearing Head".) (Refer to "Attentions for Attaching the Bearing Head".)	23
2	Bearing head (for 62M-FM flange motor)	24
3	Gasket, bearing head	24
4	Thrust roller bearing (bearing head side)	29-1

Steps	Description	Part No.
5	"O"ring, bearing head	24-1
6	Main bushing (bearing head side) (Refer to "Attentions for Replacing the Main Bushing (Bearing Head Side)".)	12-2

1. Remove the parts in the order shown in the figure.

2. Attach the parts in the reverse order of removal.

5.5.9.1 Attentions for Removing the Bearing Head (4M/6M/8M/62M)

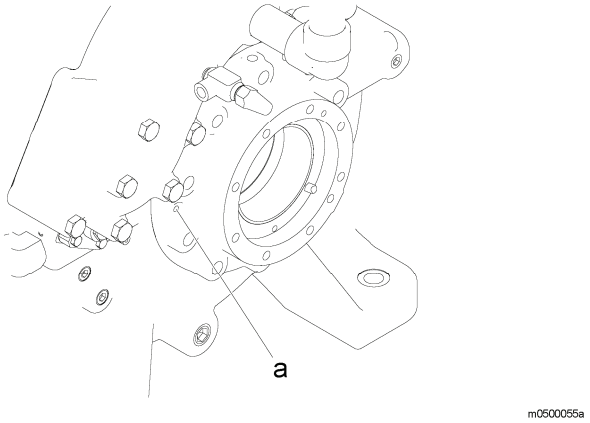
CAUTION

- **Dropping of the bearing head may cause injury or damage to the compressor. Always attach the stud bolts before performing the work.**

【POINT】

- To remove the firmly–retained bearing head, insert the bearing head hexagon head screws into the service holes (a) and tighten them. (There are two holes diagonally.)

1. Remove the two bearing head hexagon head screws from the top, and attach the stud bolts.



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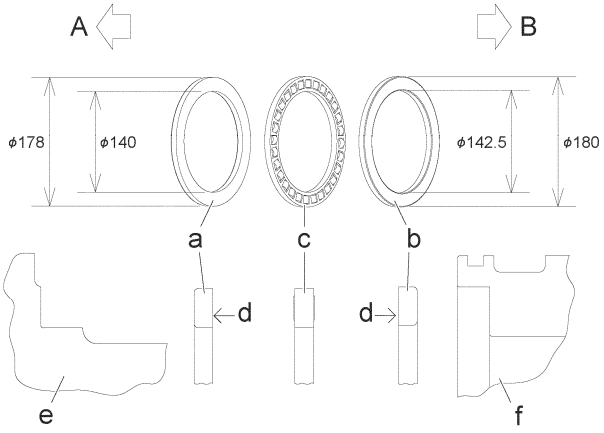
5.5.9.2 Attentions for Replacing the Main Bushing (Bearing Head Side)

If it is necessary to remove the main bushing (bearing head side), contact your local MAYEKAWA service center.

5.5.9.3 Attentions for Attaching the Thrust Roller Bearing (Bearing Head Side)

1. Attach the thrust roller bearing (bearing head side) (b) and thrust roller bearing (shaft side) (a) to the correct positions.

2. Face a flat surface (d) of the thrust roller bearing (bearing head side) (b) towards the thrust roller bearing (roller) (c).



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Symbol	Description
A	Shaft side
B	Bearing head side
e	Shaft
f	Case

5.5.9.4 Attentions for Attaching the Bearing Head (4M/6M/8M/62M)

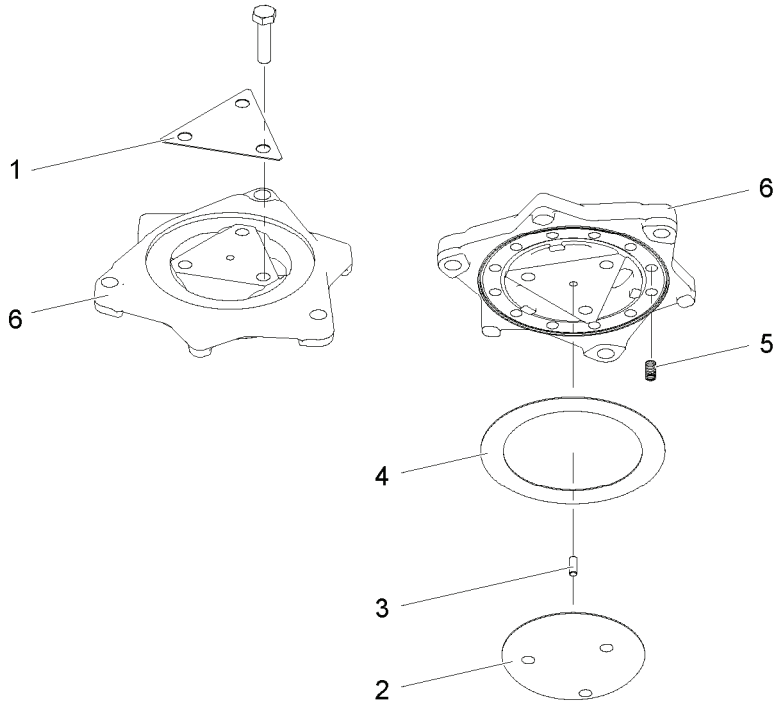
CAUTION

- **Dropping of the bearing head may cause injury or damage to the compressor. Always attach the stud bolts before performing the work.**

1. After attaching the stud bolts into the bearing head hexagon head screw holes for two sections at the top, attach the bearing head.

2. After temporarily tightening the rest of the bearing head hexagon head screws, remove the stud bolts.

5.5.10 Discharge Valve Cage Assembly



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Steps	Description	Part No.
1	Retainer, discharge valve seal bolt	112-2
2	Discharge valve seat	111
3	Parallel pin, discharge valve seat	115
4	Discharge plate valve	110

Steps	Description	Part No.
5	Spring, discharge valve (Refer to "Attentions for Attaching the Discharge Valve Spring".)	116
6	Discharge valve cage	109

1. Smooth the discharge valve seat screw baffle.

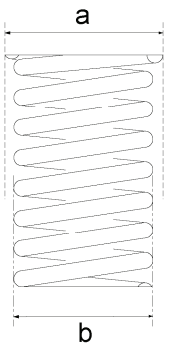
2. Remove the parts in the order shown in the figure.

3. Attach the parts in the reverse order of removal.

4. Bend the discharge valve seat screw baffle.

5.5.10.1 Attentions for Attaching the Discharge Valve Spring

1. Attach the end of the discharge valve spring with a larger diameter (a) to the discharge valve cage.



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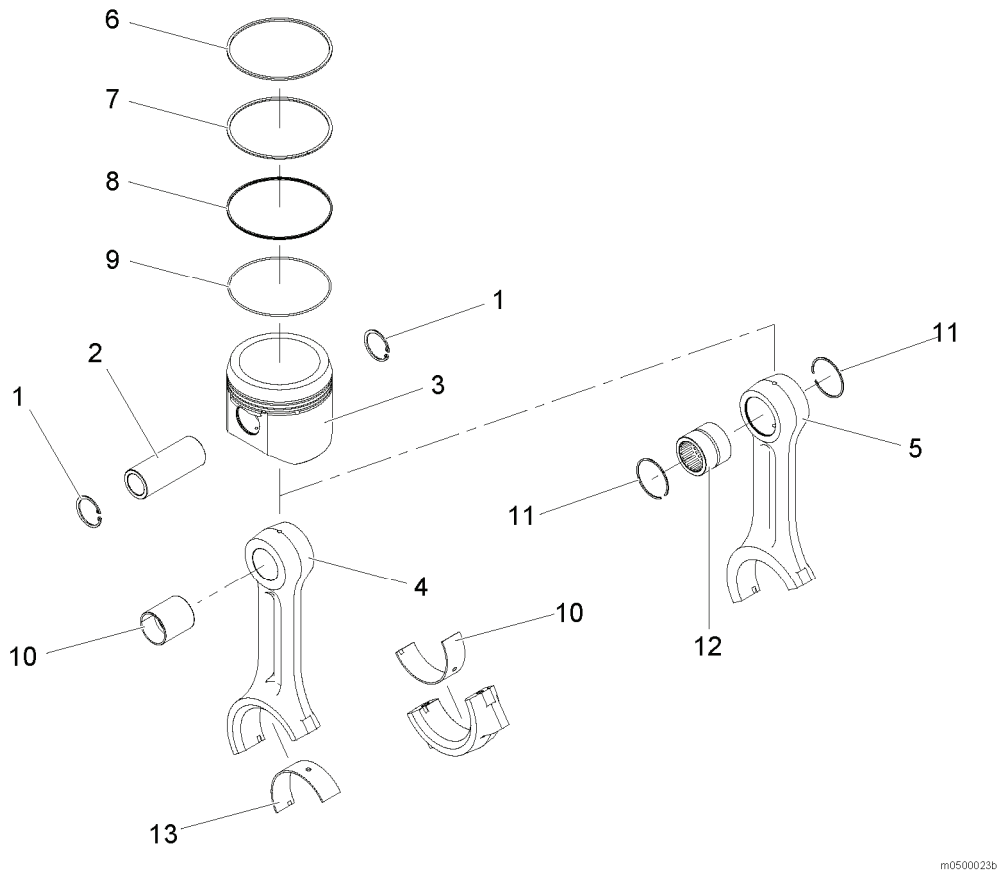
5.5.11 Piston Assembly



Steps	Description	Part No.
1	Retaining ring, piston pin	87
2	Piston pin	86
3	Piston	85
4	Connecting rod (rod)	77L or 77R
5	Connecting rod (rod) (for high stage)	
6	Piston ring (1st) (Refer to "Attentions for Attaching the Piston Rings".)	89
7	Piston ring (2nd) (Refer to "Attentions for Attaching the Piston Rings".)	90

Steps	Description	Part No.
8	Oil control ring (Refer to "Attentions for Attaching the Piston Rings".)	100
9	Coil	100
10	Bushing, connecting rod (Refer to "Attentions for Attaching the Connecting Rod Bushing/Needle Bearing".)	82
11	Circlip	
12	Connecting rod needle bearing (for high stage) (Refer to "Attentions for Attaching the Connecting Rod Bushing/Needle Bearing".)	
13	Bearing halves	84

1. Remove the parts in the order shown in the figure.

2. Attach the parts in the reverse order of removal.

5.5.11.1 Attentions for Attaching the Connecting Rod Bushing/Needle Bearing

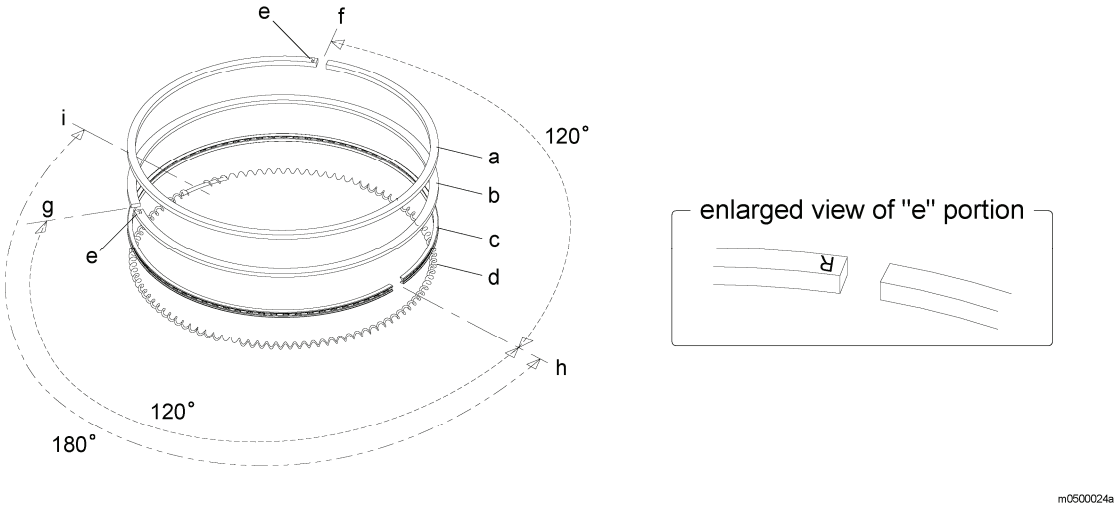
1. Align the hole of the connecting rod bushing/needle bearing with the oil hole of the connecting rod (rod).

5.5.11.2 Attentions for Attaching the Piston Rings

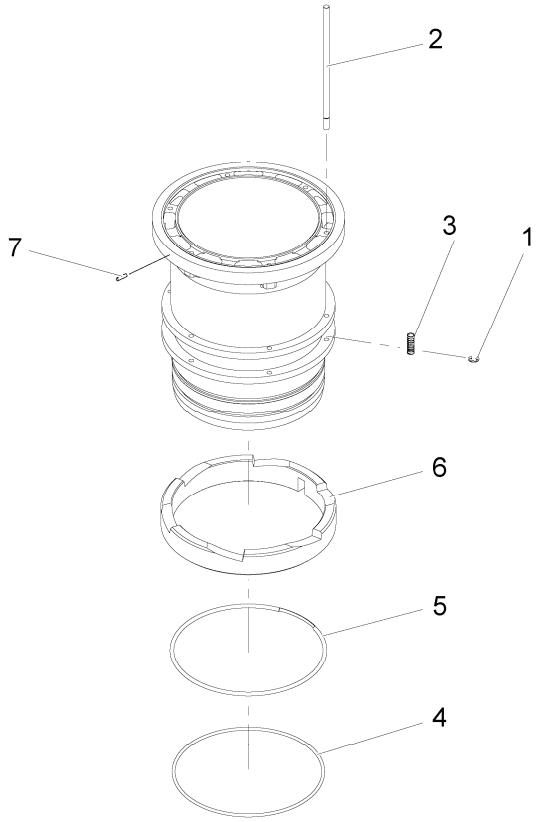
CAUTION

- **Attach the piston ring (1st) and piston ring (2nd) so that the side with a marking (R mark) faces upwards. Entry of oil may occur.**

1. Attach the piston ring (1st) (a) and piston ring (2nd) (b) so that the side with a marking (R mark) (e) faces upwards.
2. Attach the oil control ring (3rd) (c) so that the notch (h) is positioned to the opposite side of the expansion coil (d) adjustment position (i).
3. Attach the piston ring (1st) (a), piston ring (2nd) (b), and oil control ring (3rd) (c) by displacing their notches (f), (g), and (h) for 120–degree so that they are not overlapped.



5.5.12 Cylinder Sleeve Assembly



Steps	Description	Part No.
1	Stop ring, lift pin	70
2	Lift pin	68
3	Spring, lift pin	69
4	"O"ring, cylinder sleeve	67

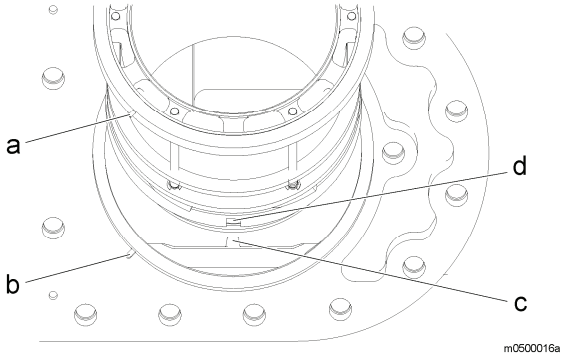
Steps	Description	Part No.
5	Retaining ring	65
6	Cam ring (Refer to "Attentions for Attaching the Cam Ring".)	62 or 63
7	Spring pin, cylinder sleeve	61-1

1. Remove the parts in the order shown in the figure.

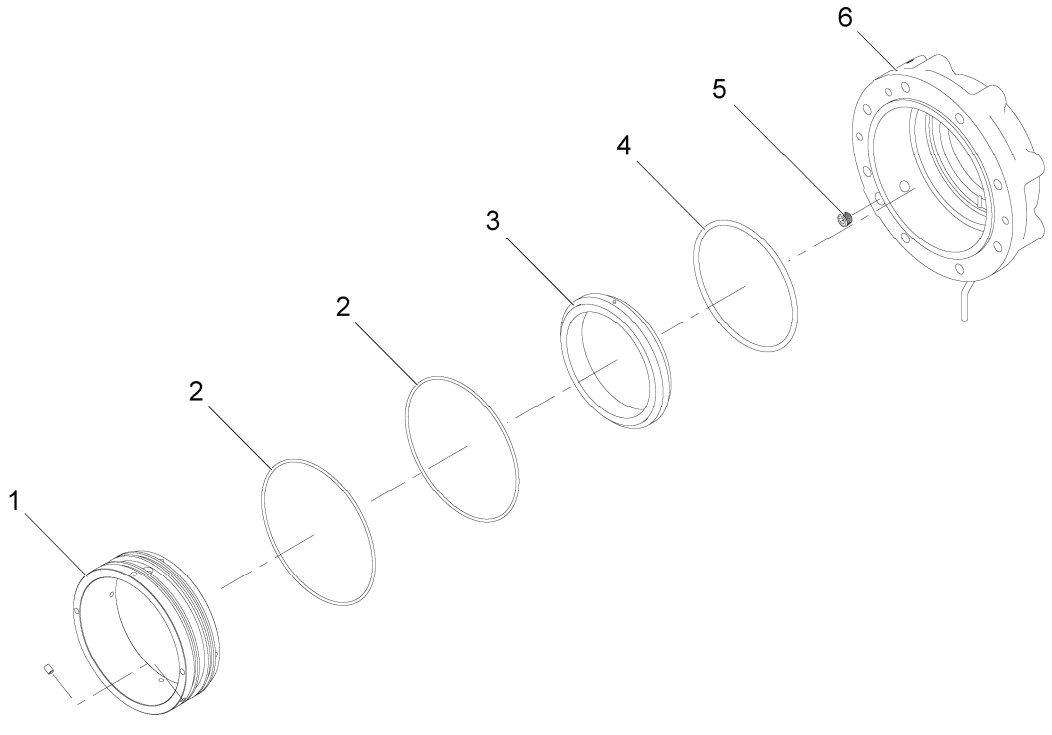
2. Attach the parts in the reverse order of removal.

5.5.12.1 Attentions for Attaching the Cam Ring

1. Verify the positions of the cylinder sleeve assembly positioning pin (a) and case groove (b), then adjust the cam ring so that the cam ring notch (d) comes directly below (the side of bushing rod tab (c)) when the assembly is attached to the crankcase.



5.5.13 Seal Cover Assembly



Steps	Description	Part No.
1	Shower flushing sleeve (Refer to "Attentions for Removing the Shower Flushing Sleeve".) (Refer to "Attentions for Attaching the Shower Flushing Sleeve".)	41-1
2	"O"ring, shower flushing sleeve	41-2

Steps	Description	Part No.
3	Mechanical seal mating ring (Refer to "Attentions for Attaching the Mechanical Seal Mating Ring".)	32
4	"O"ring, mechanical seal mating ring	42
5	Plug (R1/4 orifice φ3)	P-1
6	Shaft seal cover	26

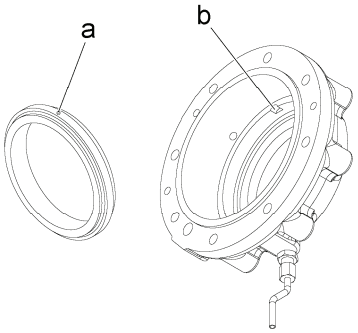
1. Remove the parts in the order shown in the figure.
2. Attach the parts in the reverse order of removal.

5.5.13.1 Attentions for Removing the Shower Flushing Sleeve

1. Loosen the shower flushing sleeve locking screw.
2. Attach the two bolts (M6) into the screw holes on the shower flushing sleeve.
3. Pull out the bolts (M6) to remove the shower flushing sleeve.

5.5.13.2 Attentions for Attaching the Mechanical Seal Mating Ring

1. Align the pin (a) of the mechanical seal mating ring with the seal cover groove (b).



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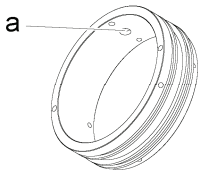
5.5.13.3 Attentions for Attaching the Shower Flushing Sleeve

1. Face the drain hole of the shower flushing sleeve (φ11) (a) upwards.



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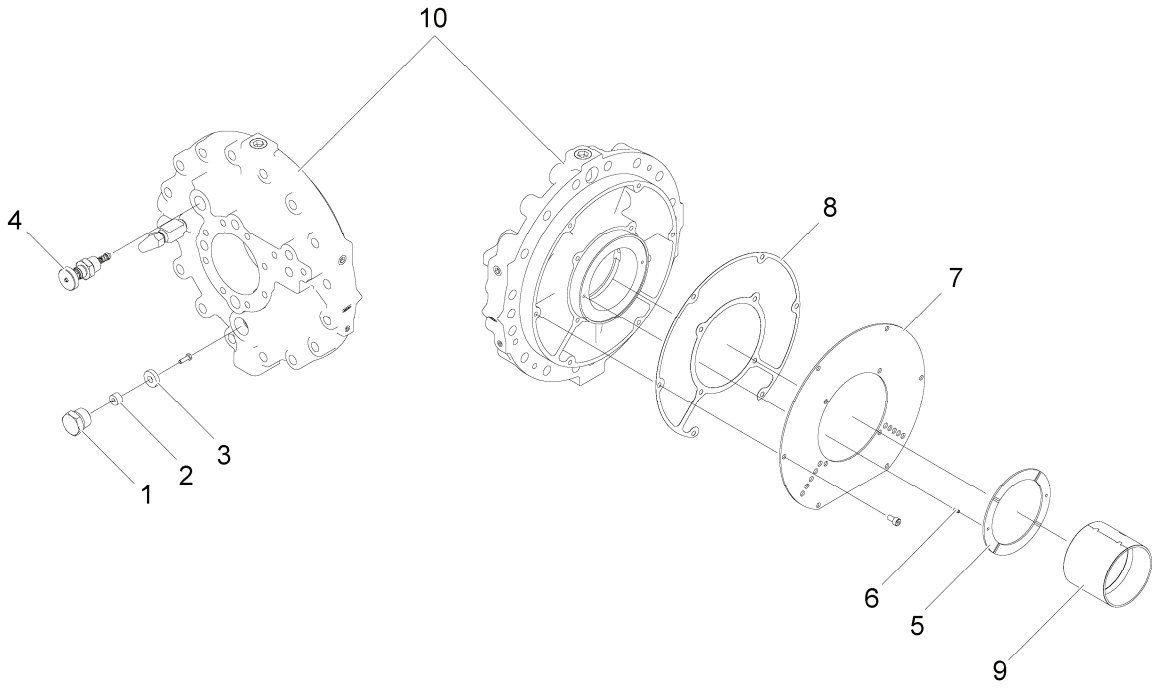
5.5.14 Main Bearing Head Assembly



Steps	Description	Part No.
1	Hexagon head plug, magnet	119-3
2	Spacer, magnet	119-4
3	Magnet	119-1
4	Oil pressure regulating valve	22
5	Thrust washer (pump side) (Refer to "Attentions for Attaching the Thrust Washer (Pump Side)".)	29
6	Spring pin, thrust washer (pump side) (Refer to "Attentions for Attaching the Thrust Washer (Pump Side)".)	13

Steps	Description	Part No.
7	Blow-by gas plate	305
8	Gasket, blow-by gas plate	306
9	Main bushing (pump side) (Refer to "Attentions for Replacing the Main Bushing (Pump Side)".)	12-1
10	Main bearing head	8

1. Remove the parts in the order shown in the figure.

2. Attach the parts in the reverse order of removal.

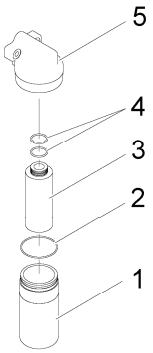
5.5.14.1 Attentions for Replacing the Main Bushing (Pump Side)

If it is necessary to remove the main bushing (pump side), contact your local MAYEKAWA service center.

5.5.14.2 Attentions for Attaching the Thrust Washer (Pump Side)

1. If the press–fit condition with the thrust washer (pump side) retaining pin is loose, widen the end of the thrust washer (pump side) retaining pin.

5.5.15 Oil Filter Assembly



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Steps	Description	Part No.
1	Oil filter case (bottom)	14
2	Oil filter case "O"ring	14-3
3	"O"ring, oil filter element	14-1
4	"O"ring, oil filter element	14-2
5	Oil filter case (top)	14

1. Remove the parts in the order shown in the figure.

2. Attach the parts in the reverse order of removal.

6 Troubleshooting

6.1 Troubleshooting Table

■ 1. Motor does not operate.

Features	Causes	Results	Countermeasures
Motor beats and does not start.	Motor failure	Breakers have tripped. Motor is burnt.	Inspect and repair or replace
	Belt tension is too high.	Breakers have tripped. Motor is burnt.	Adjust
	Voltage is dropped.	Breakers have tripped. Motor is burnt.	
	Failure/is about to be burnt/burnt of the cylinder sleeve, piston, ring, metal part (shaft seal component) (If the pulley does not rotate though you have removed the belt and rotated the pulley by hand.)	Motor is burnt. Sleeve, piston, shaft seal part are burnt.	Inspect and repair or replace
	Failure/mistake of automatic control related and electric related connections (single phase)	Automatic equipment is burnt out.	Inspect and repair
No reply though pressing the magnet switch button	Breakers have tripped.	Cannot be operated	Inspect and replace
	Failure of magnet switch contact or the protection switch is being pressed	Cannot be operated	Inspect and repair or replace
	Electric wires are cut off.	Cannot be operated	Inspect and repair or replace
	OP (low oil pressure failure protection equipment) or HP (high pressure protection equipment) is left being activated, or is not reset (recovered).	Cannot be operated	Reset (restore)
Energized when the magnet switch button is pressed, but turns off when released.	Mistake in connection (automatic control related connections)	Cannot be operated	Inspect and repair
	Contact defect of auxiliary contact or equivalent	Cannot be operated	Inspect and repair or replace
Motor stops in a short time after starting.	OP (low oil pressure failure protection equipment) is activated. (a) Refrigerant oil is run down. (b) Oil pressure is low.	Cannot be operated Sliding surface of the compressor is burnt.	(a) Supply oil. (b) Adjust the oil pressure.
	HP (high pressure protection equipment) is activated due to excessive discharge pressure. (a) Condenser is filled with non-condensable gas.	Motor is burnt, or cannot be operated.	(a) Purge air.

Features	Causes	Results	Countermeasures
	(b) Excessive suction pressure		(b) Replace the refrigerant oil in the crankcase because the load is increasing, or drain the refrigerant from the crankcase of other refrigerating machine and supply warm oil.
	OP (low oil pressure failure protection equipment) is activated due to liquid back.	Cannot be operated	Inspect and repair
	Mistake in connection between the automatic control equipment and magnet switch	Control equipment is burnt out.	Inspect and repair
	Overload relay is activated or bimetal of the OP (low oil pressure failure protection equipment) is warmed.	Cannot be started	Wait until the bimetal cools down (approx. 5 min.). In the case of OP (low oil pressure failure protection equipment), shift to manual mode and start the operation. After approx. 10 minutes, shift to automatic mode. (Note that you must investigate the cause and take an action.)

■ 2. Abnormal high pressure

Features	Causes	Results	Countermeasures
Condenser temperature is warmer than usual.	Cooling water shortage or cooling water temperature is excessively high.	HP is activated or the safety valve is opened resulting in large consumption of electricity.	Increase the volume of cooling water. Or, lower the cooling water temperature.
Head cover is overheated.	Cooling water distribution is insufficient. Or, cooling pipe is dirty.	HP is activated or the safety valve is opened resulting in large consumption of electricity.	Distribute water evenly. Or, clean the cooling pipe.
Cooling water temperature of evaporative condenser is warm.	Fan failure, or spray nozzle and strainer are clogged.	Cooling ability has decreased.	Inspect, repair, and clean
Upper part of the condenser is warm but lower part is not warm. Crankcase easily becomes frosty.	Refrigerant or refrigerant oil is accumulated in the condenser resulting in small cooling area. (a) Pipe between the condenser and receiver is clogged. (b) Refrigerant is excessive (the receiver is filled and starting to accumulate in the condenser).	Cooling ability has decreased.	(a) Inspect, adjust, and unclog (b) Wipe off the refrigerant.
Discharge pressure gauge needle is deflected and the condenser is slightly warm.	(a) Condenser is filled with air. Or, discharge pressure gauge failure	Cooling ability has decreased.	(a) Purge from the air vent valve.
	(b) Oil separator is filled with refrigerant oil and the gas is blocked by obstruction.		(b) Drain the refrigerant oil.

■ 3. Discharge pressure is too low.

Features	Causes	Results	Countermeasures
Condenser and receiver are cold.	Amount of cooling water is excessive. Or, cooling water temperature is low.	Power consumption is low and is in extremely good condition.	Adjust the regulating valve.
Liquid pipe is frosted and is in suction pressure vacuum condition.	Liquid pipe or suction pipe is clogged.	Ability falls.	Adjust the valve, inspect, and clean.
Cold head cover due to frosted crankcase	Expansion valve is opened too much resulting in wet compression (low suction temperature due to liquid back).	Discharge area of cooler may be damaged due to liquid hammer.	Narrow the expansion valve during operation.
Suction pressure is low and there is a leak sound from the expansion valve.	Refrigerant shortage	Does not become cold	Fill with refrigerant.
High suction pressure	Gas leakage due to wear of the suction valve, discharge valve, or ring	Ability decreased and sleeve is burnt.	Inspect and repair or replace the valve part and ring.

■ 4. Excessive suction pressure

Features	Causes	Results	Countermeasures
Crankcase is frosted.	Expansion valve is opened too much.	Liquid hammer occurs.	Adjust operation (narrow the expansion valve).
Value on the ammeter increased (current consumption; in the case when the refrigerating load is normal).	Load has increased.	Motor is burnt.	Adjust operation.
Discharge pressure is low. Suction side is not frosted.	Ability of refrigerating machine decreased (gas leakage from suction/discharge valve and sleeve) or gas leakage from safety valve	Does not become cold	Disassemble for inspection and replace the parts.

■ 5. Suction pressure is too low.

Features	Causes	Results	Countermeasures
Refrigerator room temperature or brine temperature is higher than suction pressure.	Refrigerant shortage or expansion valve is throttled too much.	Does not become cold	Fill with refrigerant or adjust operation.
Liquid back occured when the expansion valve is opened.	(a) Cooling pipe is filled with refrigerant oil.	Does not become cold	(a) Drain the refrigerant oil from the drain valve.
	(b) Cooling pipe is frosted or iced too much.		(b) Defrost
Suction pressure is low, compared to refrigerator room temperature or brine temperature, from the beggining of operation	(a) Cooling pipe and the suction pipe are thin compared to the length. Or, resistance is too high.	Does not become cold	(a) Mistake in piping or layout. Investigate and improve
Suction pressure is low compared to the pressure at the beggining of operation	(b) Gas strainers in the refrigerator and suction pipe are blocked by rust or dust.		(b) Cleaning

■ 6. Abnormal noise during operation

Features	Causes	Results	Countermeasures
Continuous metal sound occurs.	(a) Foreign material is stuck in between the cylinder head and piston.	Discharge area and shaft of the piston may be damaged.	(a) Disassemble, maintain, and replace
	(b) Discharge valve, suction valve, and piston ring are damaged.		(b) Disassemble and replace
Shaft seal part is heated.	(a) Metal is worn, burnt, or damaged.	Discharge area and shaft of the piston may be damaged.	Disassemble and replace (Note that supply pipe may be blocked.)
	(b) Oil pump damage	May be burnt	Stop operation, investigate cause, and replace
Crankcase is frosted.	Liquid back	Discharge area and piston may be damaged.	Stop operation, investigate cause, and replace Narrow the expansion valve during operation. If intense, narrow the suction stop valve and open it gradually.
Large discharge noise at head cover	Oil hammer	Discharge area and piston may be damaged.	Prevent entry of oil (if liquid back occurs at the same time, also perform the countermeasure above.)

■ 7. Crankcase is heated.

Features	Causes	Results	Countermeasures
Head cover is overheated. (High discharge pressure. High suction pressure)	(a) Compression ratio has increased. (Condensed temperature has increased or refrigerant load has increased.)	Oil is burnt, carbon has adhered.	Increase cooling water for condenser. Or, higher the cooling water temperature.
	(b) Refrigerant oil is burnt resulting in carbon accumulation and blocked gas passage.	Metal is worn and damaged, and sleeve is burnt.	Disassemble, inspect, and clean or replace
	(c) Discharge valve plate is damaged, or gas leakage	Cooling ability has decreased.	Disassemble, inspect, and replace
	(d) Gas leakage from safety valve	Cooling ability has decreased.	Lower the discharge pressure, adjust the safety valve.
Rise of oil temperature	Pump is heated due to oil cooler failure, refrigerant oil shortage, comtaminated oil, or oil filter blockage.	Carbon has adhered and burnt.	Clean and increase cooling water volume of oil cooler, replace the refrigerant oil, clean the oil filter.
Flow of the refrigerating machine cooling water is insufficient.	Cooling water shortage or water passage is blocked	Metal is worn and burnt, and carbon has adhered to the discharge area.	Lubricant deterioration, clean and increase the volume of cooling water
Shaft seal part is especially hot.	Sliding section is about to be burnt.	Sliding section is burnt or damaged.	Repair or replace.

■ 8. Excessive oil consumption

Features	Causes	Results	Countermeasures
Crankcase tends to be frosted.	Forming of refrigerant occurs due to liquid back. Especially during vacuum operation	Cannot be operated	Adjust operation.
There is no other error.	Pressure equalizer hole of the crankcase is blocked (opened too much during vacuum operation). Or, suction strainer is clogged.	Oil hammer occurs.	Inspect and clean, or clean the strainer
	Wear on the piston ring		Replace the piston ring
	Attachment of the piston ring is inappropriate		Reattach properly
Head cover is overheated.	Refrigerant oil is burnt out due to abnormal high pressure.	Carbon is accumulated.	Lower the discharge pressure
Value on the ammeter increased (current consumption; in the case when the refrigerating load is normal).	Cylinder sleeve is damaged, is about to be burnt, or score due to wear on the ring.	Sleeve and piston are burnt.	Inspect and adjust or replace
Excessive oil pressure	Oil pressure is excessive (in the case when the refrigerant oil viscosity is normal).	Oil hammer	Adjust
Oil pressure is low.	Refrigerant oil viscosity is low and light. (Air bubble is mixed in, or rise of oil temperature.)	Sliding section is burnt.	Adjust and replace the refrigerant oil.
Crankcase is overheated.	Overheat operation (due to high discharge pressure)	Refrigerant oil viscosity is low. Carbon has adhered.	Replace with the new refrigerant oil of wich viscosity is normal (lower the discharge pressure).

■ 9. Does not become cold

Features	Causes	Countermeasures
Suction pressure does not become low.	Deficiency in performance (a) Refrigerating machine (b) Cooling pipe (c) Condenser	Inspect and expand if the condition is normal. (a) Expansion (b) Expansion (c) Inspect and expand if the condition is normal.
	Load has increased.	Continue operation if temporary. Expand if continues.
	Lack or deterioration of heat insulator	Inspect, readjust the installation condition, and repair
	Abnormal high pressure	Lower the discharge pressure (Increase the volume of cooling water, expand the condenser, clean the condenser, expel air.)
	Gas leakage	Inspect and repair
Low suction pressure (Suction pipe is not frosted, liquid back tends to occur.)	Heat operation (Expansion valve is narrowed too much.)	Adjust the expansion valve (open).
	Cooling pipe is small in length.	Expansion
	Cooling pipe is frosted too much.	Defrost
	Cooling pipe is filled with refrigerant oil.	Drain the oil.
	Suction line is narrowed.	Readjust the piping.
High discharge pressure	Cooling water shortage or cooling water temperature rise	Increase the volume of water.
	Deficiency in condenser performance	Expansion
	Condenser cooling surface is dirty.	Cleaning
High discharge pressure (Lower part of the condenser is cold, receiver is filled with refrigerant.)	Refrigerant is excessive.	Drain the excessive refrigerant.
	Discharge line pipe is clogged.	Readjust the piping.
Too much entry of oil (Increase in discharge temperature)	Wear on the piston ring	Replace
	Score	Inspect and repair
	Gas leakage	Inspect and repair

7 Related Document

7.1 Development View and Configuration Table of the Parts

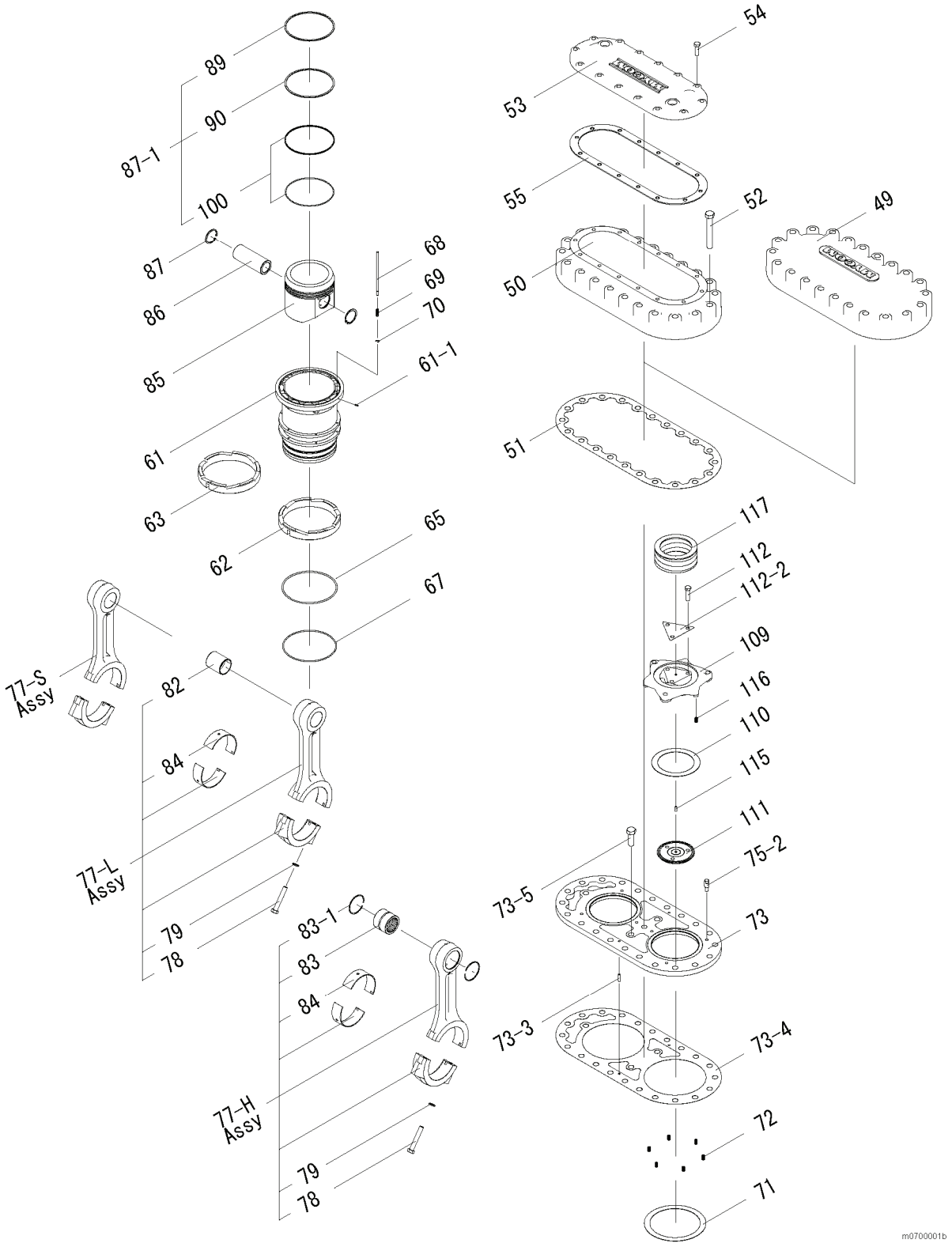


Fig. 7-1 Development view of M series cylinder part

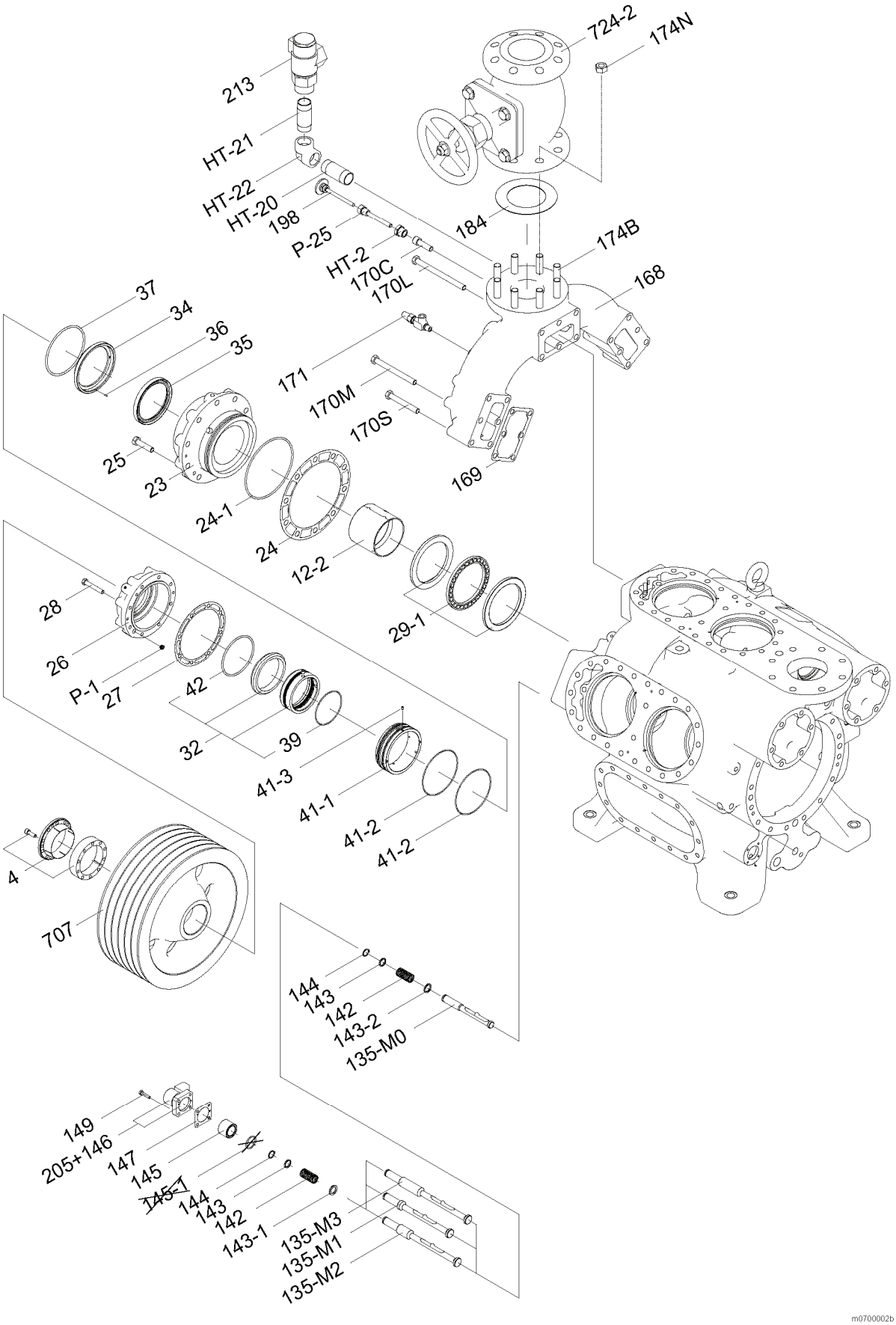


Fig. 7-2 Development view of parts around the 6M case and parts common with others (1/2)

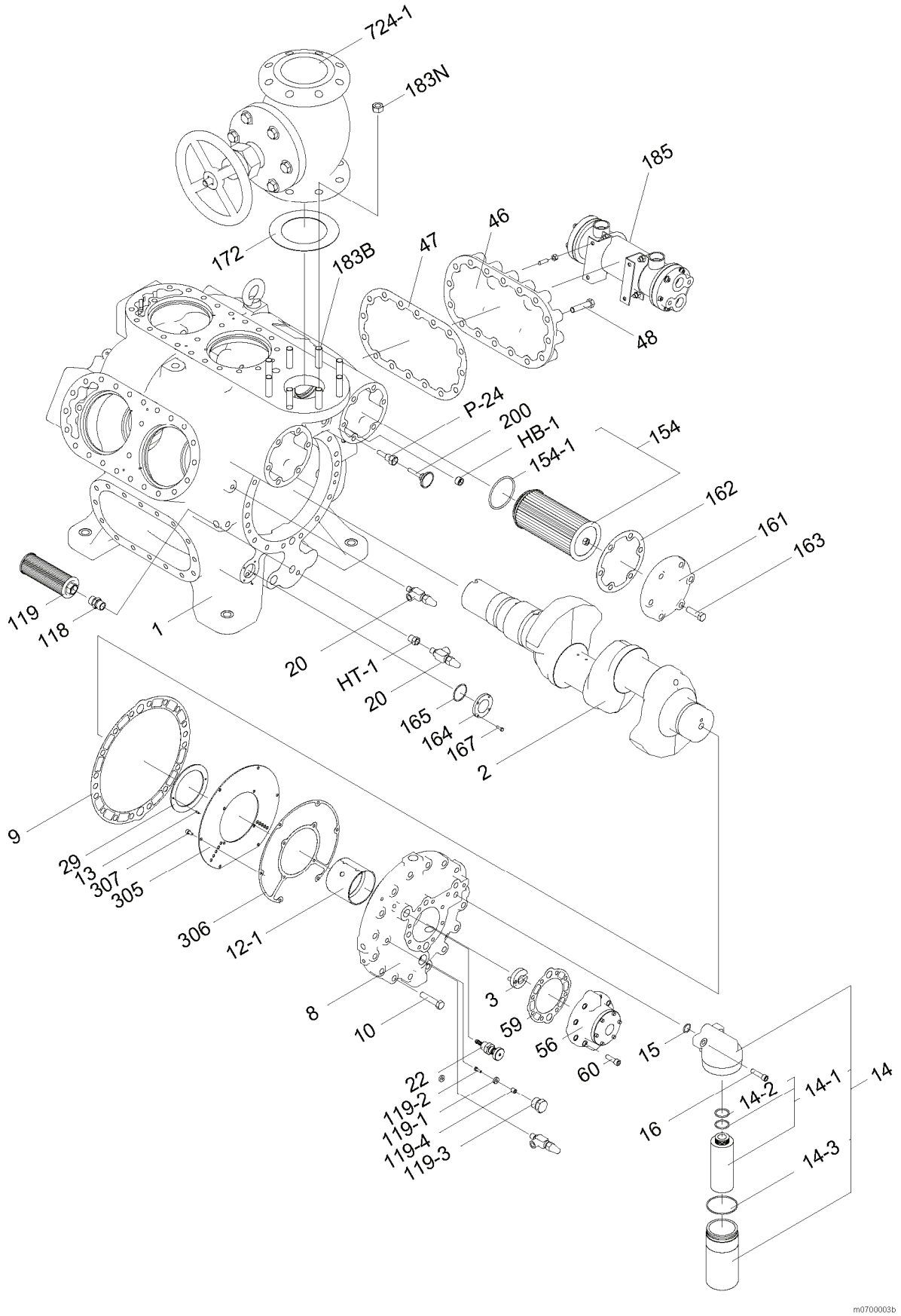


Fig. 7-3 Development view of parts around the 6M case and parts common with others (2/2)

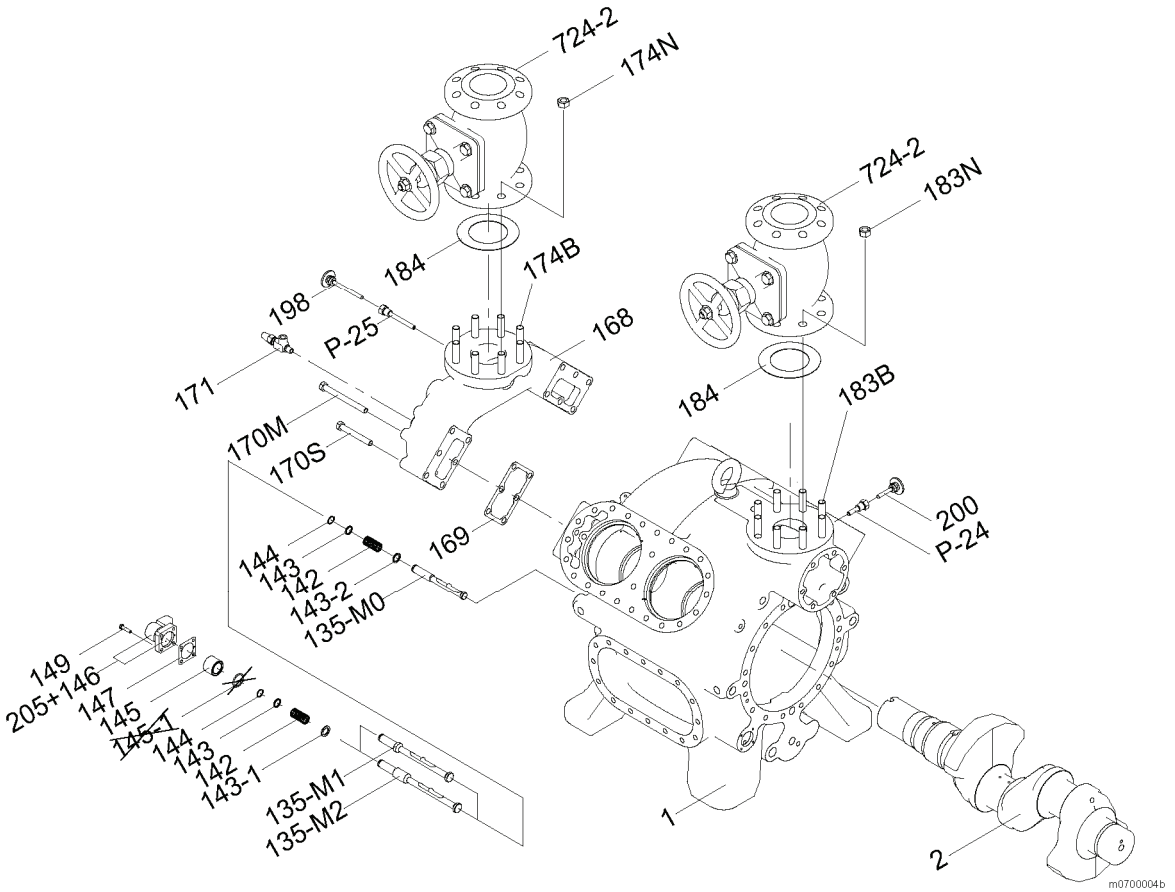


Fig. 7-4 Development view of parts around the 4M case

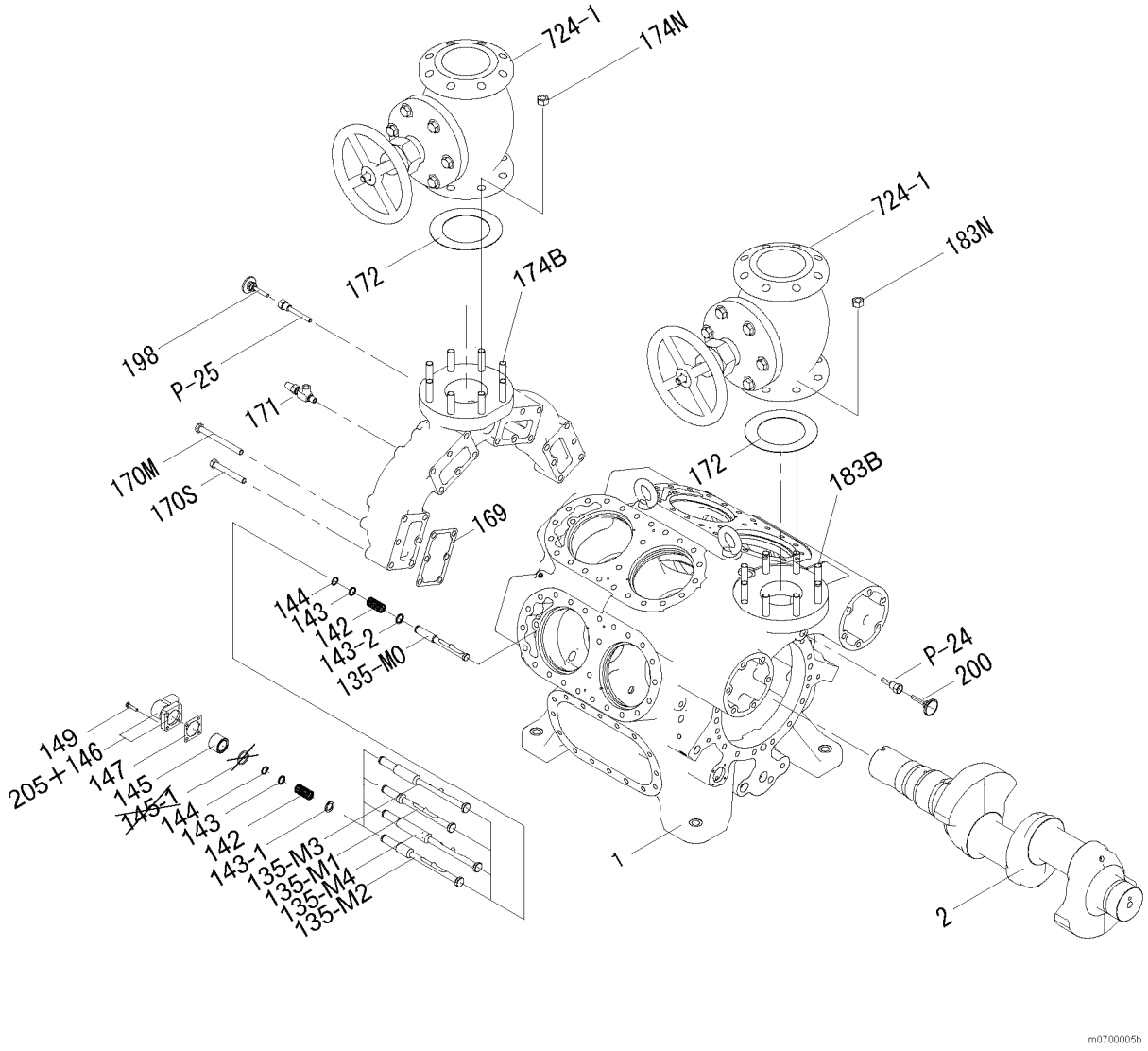


Fig. 7-5 Development view of parts around the 8M case

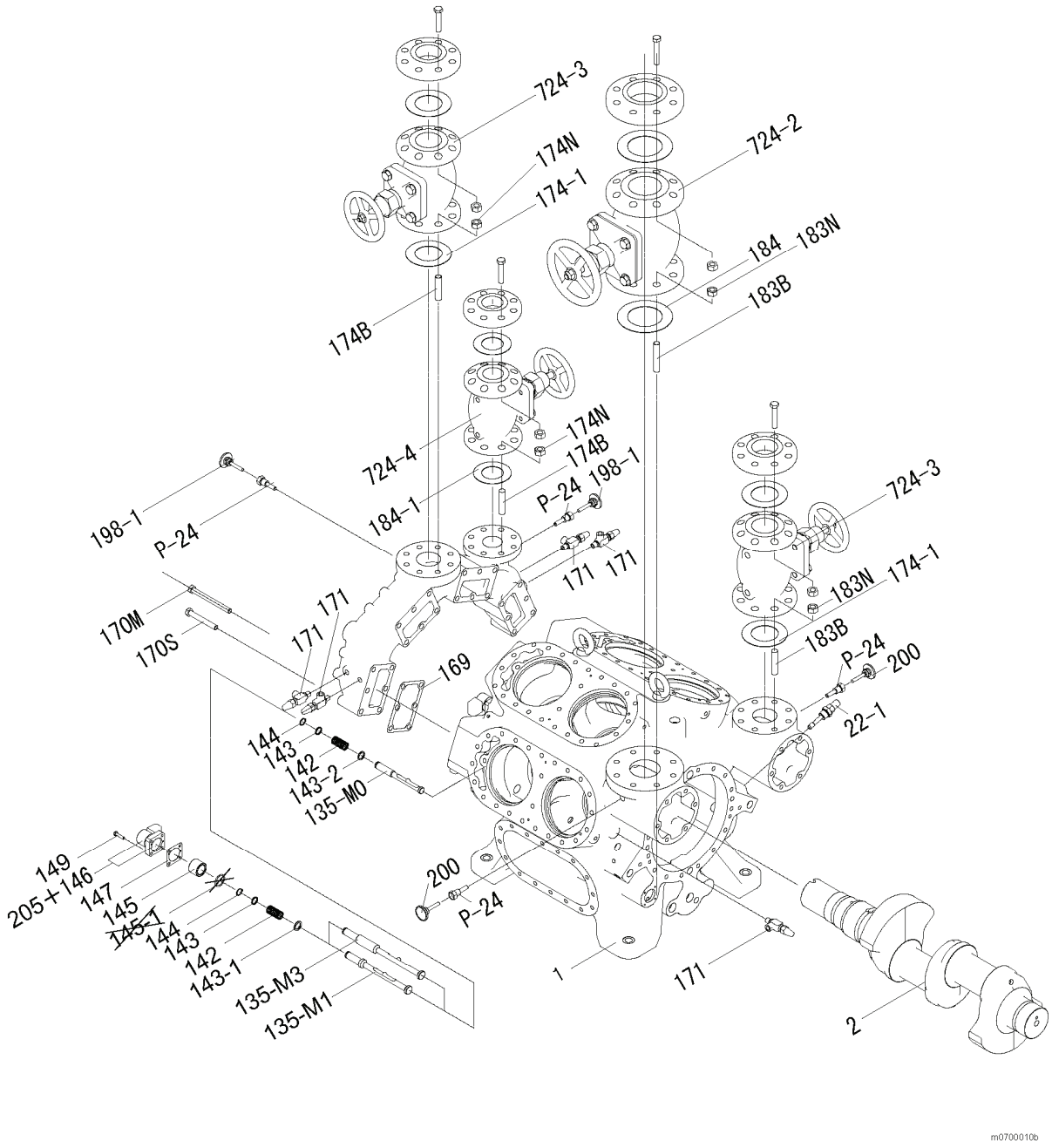


Fig. 7-6 Development view of parts around the 62M case

Table 7-1 Parts Configuration Table

Part Number	Part name	Material	Qty.				Remarks
			4M	6M	8M	62M (std)	
1	Crankcase	FC	1	1	1	1	
2	Crankshaft	FCD	1	1	1	1	
3	Drag crank	S45C	1				Same as 12B
4	Mechlock	-	1				
8	Main bearing head	FC	1				
9	Main bearing gasket	Asbestos-free	1				
10	Hexagon head bolt, main bearing head	SCM435	1				M16×L75-10.9
12-1	Main bushing (pump side)	Steel, Aluminum alloy	1				
12-2	Main bushing (seal side)	DS10,A40	1				
13	Spring pin, thrust washer	SK5	2				Spring pin 5×10AV
14	Oil filter assembly	ADC12,A6061	1				20μm
14-1	Element, oil filter w/"O"ring	PA.NBR	1				
14-2	“O”ring, oil filter element	NBR	2				AS568 -222
14-3	“O”ring, oil filter case	NBR	1				JISB2401 G90
15	“O”ring, Oil filter head	NBR	2				JISB2401 G25
16	Hexagon socket head cap screw, oil filter	SCM435	2				M12×L50-12.9
22	Oil pressure regulating valve	-	1				Same as WA and WB (R3/4)
23	Bearing head	FC	1				
24	Gasket, bearing head	Asbestos-free	1				
24-1	“O”ring, bearing head	NBR	1				JISB2401 G200
25	Hexagon head bolt, bearing head	SCM435	10				M16×L65-10.9
26	Shaft seal cover	FC	1				
27	Gasket, shaft seal cover	Asbestos-free	1				
28	Hexagon head bolt, shaft seal cover	SCM435	8				M12×L75-10.9
29	Thrust washer (pump side)	Steel, Aluminum alloy	1				
29-1	Thrust roller bearing	-	1				
32	Mechanical seal assembly	-	1				BBSφ110
34	Retainer, oil seal	FC	1				
35	Oil seal	NBR,SPCC	1				NOK AB4399A0
36	Spring pin, seal retainer	SK5	1				Spring pin 3×10AW
37	“O”ring, oil seal retainer	NBR	1				JISB2401 G160
39	“O”ring, mechanical seal collar	NBR	1				AS568 -245
41-1	Shower flushing sleeve	FC	1				
41-2	“O”ring, shower flushing sleeve	NBR	2				AS568 -257
41-3	Hexagon socket set screw, shower flushing sleeve	SCM435	3				M6×L8
42	“O”ring, mechanical seal mating ring	NBR	1				JISB2401 P130
46	Hand hole cover	FC	2				
47	Gasket, hand hole cover	Asbestos-free	2				
48	Hexagon head bolt, hand hole cover	SCM435	32				M16×L75-10.9
49	Head cover (air cooled)	FC	2	3	4	4	Water cooled specification
50	Head cover (water cooled)	FC	2	3	4	4	Water cooled specification
51	Gasket, head cover	Asbestos-free	2	3	4	4	
52	Hexagon head bolt, head cover	SCM435	44	66	88	88	M16×L115-10.9
53	Head jacket cover	FC	2	3	4	4	For water cooled head cover
54	Hexagon head bolt, head jacket cover	SUS304	28	42	56	56	M10×L35-SUS/ Water cooling head cover specification

Part Number	Part name	Material	Qty.				Remarks
			4M	6M	8M	62M (std)	
55	Gasket, head jacket cover	Natural rubber	2	3	4	4	For water cooled head cover
56	Oil pump assembly	-	1				MG
59	Gasket, oil pump	Asbestos-free	1				
60	Hexagon socket head cap screw, oil pump	SCM435	8				M12×L40-12.9
61	Cylinder sleeve	FC250	4	6	8	8	
61-1	Spring pin, cylinder sleeve	SK5	4	6	8	8	Spring pin 3×10AW
62	Cam ring (rightward sloped)	FC	4	6	4	-	
63	Cam ring (leftward sloped)	FC	-	-	4	4	
65	Retaining ring	SWC	4	6	8	4	
67	“O”ring, cylinder sleeve	NBR	4	6	8	8	AS568 -258
68	Lift pin	S50C-10D	24	36	48	24	ϕ6×L155
69	Spring, lift pin	SWC	24	36	48	24	KK1090
70	Stop ring, lift pin	S60CM	24	36	48	24	Retaining ring E5
71	Suction plate valve	SUS	4	8	6	8	
72	Spring, suction valve	SWPA	24	36	48	48	Type IV
73	Valve plate	FC	2	3	4	4	Pay attention to the stamped specification
73-3	Parallel pin, valve plate	S45C	4	6	8	8	Parallel pin B - 6×25st
73-4	Gasket, valve plate	Asbestos-free	2	3	4	4	
73-5	Hexagon head bolt, valve plate	SCM435	6	6	12	12	M16×L45-10.9
73-2	Stud bolt, discharge valve cage	S45C	12	18	24	24	
77-SAssy	Connecting rod (No.1)	AC	-	2	4	2	W36,L310, bushing
77-LAssy	Connecting rod (No.2)	AC	4	4	4	4	W46,L310, bushing
77-HAssy	Connecting rod (High grade)	AC	-	-	-	2	W36,L310, Needle bearing
78	Hexagon head bolt, connecting rod	SCM	8	12	16	16	M12×L80
79	Disk Lock Washer, connecting rod	S45C	8	12	16	16	NL12
82	Bushing, connecting rod	Steel, LBC	4	6	8	6	φ45×L56×t2.5
83	Connecting rod needle bearing	-	-	-	-	2	φ45×φ59×L52
83-1	Circlip	SWRH	-	-	-	4	φ59
84	Bearing halves	Steel, Aluminum alloy	8	12	16	16	Same shape for upper and lower
85	Piston	AC8AT6	4	6	8	8	
86	Piston pin	SCM	4	6	8	8	
87	Retaining ring, piston pin	SK5	12	12	16	16	Retaining ring H45
89	Piston ring (1st)	Steel	4	6	8	8	SP-PC-BF2.5
90	Piston ring (2nd)	FC	4	6	8	8	FC-T2.0
100	Oil control ring (3rd) with coil	Steel	4	6	8	8	SP-PC-DM3.0
109	Discharge valve cage	FCD	4	6	8	8	Pay attention to the stamped specification
110	Discharge plate valve	SUS	4	6	8	8	
111	Discharge valve seat	SCM435	4	6	8	8	
112	Hexagon head bolt, discharge valve seat	SCM435	12	18	24	24	M10×L40-10.9
112-2	Retainer, discharge valve seat bolt	SPCC	4	6	8	8	
115	Parallel pin, discharge valve seat	S45C	4	6	8	8	Parallel pin B - 6×15st
116	Spring, discharge valve	SWPA	48	72	96	96	Type IV
117	Spring, safety head	SWI-200	4	6	8	8	
118	Hexagon head nipple (R3/4)	SS400	2				For oil strainer and oil cooler piping
119	Oil strainer	SUS304	1				100 mesh
119-1	Magnet	Neodymium	1				φ20×φ8×t5
119-2	Hexagon head bolt, magnet	SCM435	1				M8×L15-10.9
119-3	Hexagon head plug, magnet	SS400	1				Hexagon head plug (special, R1")
119-4	Spacer, magnet	-	1				

Part Number	Part name	Material	Qty.				Remarks
			4M	6M	8M	62M (std)	
135-M0	Unloader push rod (No.0)	AC	2	3	4	2	L208, Same for all suction side cylinder
135-M1	Unloader push rod (No.1)	AC	1	1	1	1	L286.5 is used
135-M2	Unloader push rod (No.2)	AC	1	1	1	-	L322.5 is used
135-M3	Unloader push rod (No.3)	AC	-	1	1	1	L358.5 is used
135-M4	Unloader push rod (No.4)	AC	-	-	1	-	L394.5 is used
142	Spring, unloader device	-	4	6	8	4	KS4091
143	Washer (No1), unloader push rod	SPCC	4	6	4	4	φ27×φ22.2×t3
143-1	Washer (No2), unloader push rod	SPCC	2	3	4	2	φ32.8×φ23×t3
143-2	Washer (No3), unloader push rod	SPCC	2	3	4	2	φ29.8×φ23×t3
144	Retaining ring, unloader push rod	SK5	4	6	8	4	STW22
145	Unloader piston	FC	2	3	4	2	φ48
~~145-1~~	~~"O"ring, unloader piston~~	~~NBR~~	~~2~~	~~3~~	~~4~~	~~2~~	~~JISB2401G35~~
146+205	Unloader Cover (built in solenoid valve)	AC	2	3	4	2	SB36A, same as K and L series
147	Gasket, unloader cover	Asbestos-free	2	3	4	2	Same as K and L series
149	Hexagon head bolt, unloader cover	SCM435	8	12	16	8	M8×L35-10.9 (Same as K and L series)
154	Suction filter W/"O"ring	SUS	1	2	2	2	200 mesh (75 μm)
154-1	"O"ring, suction filter	NBR	1	2	2	2	JISB2401 G105
161	Suction filter cover	FC	1	2	2	2	
162	Gasket, suction filter cover	Asbestos-free	1	2	2	2	
163	Hexagon head bolt, suction filter cover	SCM	6	12	12	12	M16×L55-10.9
164	Oil sight glass	-	1				
165	"O"ring, oil sight glass	NBR	1				AS568 -137
167	Hexagon head bolt, oil sight glass	SCM435	4				M6×L20-10.9
168	Discharge manifold	FC	1	1	1	1	
169	Gasket, discharge manifold	Asbestos-free	2	3	4	4	
170L	Hexagon head bolt (No.1), discharge manifold	SCM435	-	3	-	-	M16×L200-10.9
170M	Hexagon head bolt (No.2), discharge manifold	SCM435	8	10	20	18	M16×L170-10.9
170S	Hexagon head bolt (No.3), discharge manifold	SCM435	4	4	4	6	M16×L120-10.9
170C	Hexagon socket head cap screw (No.4), discharge manifold	SCM435	-	1	-	-	M16×L55-12.9
20 171	Service valve	-	6			8	JR3/8×Rc3/8 For oil drain/initial oil charge, gas purge, connection for suction/discharge/oil pressure
22-1	High stage return oil valve assembly	-	-	-	-	1	
174B,183B	Hexagon head bolt, Shut-off valve	SCM435	16	16	16	32	M20×L95 Stud bolt
174N,183N	Hexagon head bolt, Shut-off nut	S45C	16	16	16	32	M20
172	Gasket, Shut-off valve	Asbestos-free	-	1	2	-	125A(ANSI#300),t1.5
184	Gasket, Shut-off valve	Asbestos-free	2	1	-	1	100A(ANSI#300),t1.5
174-1	Gasket, Shut-off valve	Asbestos-free	-	-	-	2	80A(ANSI#300),t1.5
184-1	Gasket, Shut-off valve	Asbestos-free	-	-	-	1	65A(ANSI#300),t1.5
724-1	Shut-off valve	-	-	1	2	-	GVF125A(ANSI)
724-2	Shut-off valve	-	2	1	-	1	GVF100A(ANSI)
724-3	Shut-off valve	-	-	-	-	2	GVF80A(ANSI)
724-4	Shut-off valve	-	-	-	-	1	GVF65A(ANSI)
185	Oil cooler (water cooled)	-	1				T-TCF-0.5
198	Thermometer, discharge side	-	1	1	1	-	BT–T–50 (50—200°C)
198-1	Thermometer, discharge side	-	-	-	-	2	BT–T–50 (0—150°C)

Part Number	Part name	Material	Qty.				Remarks
			4M	6M	8M	62M (std)	
200	Thermometer, suction side	-	1	1	1	2	BT–T–50 (–50—+50°C)
208	Eyebolt	SF390	-	2	2	2	M24
	Eyebolt	SF390	1	-	-	-	M30
213	Safety valve	-	-	-	1	-	32 A
			-	1	-	1	25 A
			1	-	-	1	20 A
305	Blow-by gas plate	SPCC	1				
306	Gasket, blow-by gas plate	Asbestos-free	1				
307	Hexagon socket head cap screw, blow-by gas plate	SCM435	10				M8×L15-12.9
707	Flywheel	FCD	1				For belt drive
HB-1	Screw plug	S45C	-	2	2	-	MSW24
HB-2	Hexagon socket set screw	S45C	4				M10×L35, for attaching oil cooler
HN-1	Hexagon nut	S45C	4				M10 for attaching oil cooler
P-1	Plug (R1/4 orifice φ3)	S45C	1				For seal oil drain
P-2	Plug (R1/8)	S45C	3	4	5	3	For unloader and seal oil supply
P-3	Plug (R1/4)	S45C	8	8	12	11	For seal oil drain, oil drain and relief
P-4	Plug (R3/8)	S45C	3	3	3	3	For suction chamber and shaft
P-5	Plug (R1/2)	S45C	6	6	5	5	For MBH, OS return and internal oil line
P-6	Plug (R3/4)	S45C	9	5	8	7	For unloader, internal oil line and oil supply
P-7	Plug (R1")	S45C	5	6	5	5	For heater, MBH, pressure equalizer
P-8	Plug (R1"1/4)	S45C	-	-	1	-	For safety valve
HT-1	Bushing (R1/2×Rc3/8)	S45C	1				For oil drain
HT-2	Bushing (R3/4×Rc1/2)		-	1	-	-	For thermometer at discharge
HT-3	Bushing (R3/4×Rc3/8)		1				For initial oil charge
HT-4	Bushing (Rc5/4×R3/4)		2				For OC piping
HT-5	Street elbow (High pressure, R3/4×Rc3/4)		-	1	-	-	For OC piping
HT-6	Connection (L-type, R3/4×φ27)		3	4	3	3	For OC piping
HT-7	Connection (L-type, R1/4×φ10)	-	-	4	-	-	For oil drain
HT-8	Connection (I-type, R3/4×φ27)	-	1	-	1	1	For OC piping
HT-9	Connection (I-type, R1/4×φ10)	-	4	-	-	-	
HT-10	Connection (I-type, R3/8×φ6)	-	3			4	For suction, discharge and oil pressure
HT-11	Connection (I-type, R1/8×φ6)	-	1				For seal drain
HT-12	Pipe, oil cooler	STPG	2	2	2	2	20A pipe
HT-13	Pipe, oil drain	-	2	2	-	-	φ10 pipe
HT-14	Pipe, seal drain	-	1				φ6 pipe
HT-15	Hose nipple (R3/8)	STPG	3			4	For oil drain, initial oil charge and purging
HT-16	Hose nipple (R3/4)	STPG	6	8	10	10	For water cooled head cover and OC cooling water
HT-17	Street elbow (R3/4×Rc3/4)	-	5	7	9	9	For water cooled head cover and OC cooling water
HT-18	Hose band (20A)	-	4	6	8	8	For water cooled head cover
HT-19	Blade hose (20A)	-	3m	3m	4m	4m	For water cooled head cover

Part Number	Part name	Material	Qty.				Remarks
			4M	6M	8M	62M (std)	
HT-20	Nipple	STPG	-	-	1	-	R5/4×L100
			-	1	-	1	R1”×L100
			1	-	-	1	R3/4×L100
HT-21	Nipple (Special)	STPG	-	-	1	-	NPT5/4×R5/4×L100
			-	1	-	1	NPT1"×R1"×L100
			1	-	-	1	NPT3/4×R3/4×L100
HT-22	Elbow (High pressure)	-	-	-	1	-	Rc5/4×Rc5/4
			-	1	-	1	Rc1"×Rc1"
			1	-	-	1	Rc3/4×Rc3/4
P-24	Thermometer plug	SS400	1	1	1	4	R1/2×L50
P-25	Thermometer plug		1	1	1	-	R1/2×L100

7.2 List of Tightening Torques for Bolts and Nuts

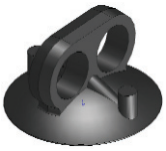
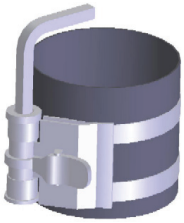
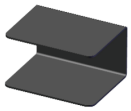
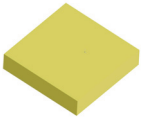
Table 7-2 List of tightening torques for bolts and nuts

Part No.	Part name	Material	Qty.			Remarks	Tightening torque	
			4M	6M	8M		N·m	kgf·cm
10	Hexagon head bolt, main bearing head	SCM435	16			M16×L75-10.9	120	1200
307	Hexagon socket head cap screw, blow-by gas plate	SCM435	10			M8×L15-12.9	40	400
16	Hexagon socket head cap screw, oil filter	SCM435	2			M12×L50-12.9	80	800
60	Hexagon socket head cap screw, oil pump	SCM435	8			M12×L40-12.9	80	800
119-2	Hexagon head bolt, magnet	SCM435	1			M8×L15-10.9	-	
25	Hexagon head bolt, bearing head	SCM435	10			M16×L65-10.9	120	1200
41-3	Hexagon socket set screw, shower flushing sleeve	SCM435	2			M6×L8	-	
28	Hexagon head bolt, shaft seal cover	SCM435	8			M12×L75-10.9	80	800
48	Hexagon head bolt, hand hole cover	SCM435	32			M16×L75-10.9	120	1200
73-5	Hexagon head bolt, valve plate	SCM435	6	9	12	M16×L45-10.9	120	1200
112	Hexagon head bolt, discharge valve seat	SCM435	12	18	24	M10×L40-10.9	60	600
52	Hexagon head bolt, head cover	SCM435	44	66	88	M16×L115-10.9	120	1200
54	Hexagon head bolt, head jacket cover	SUS304	28	42	56	M10×L35-SUS/ Water cooling head cover specification	-	
78	Hexagon head bolt, connecting rod	SCM435	8	12	16	M12×L80	60	600
149	Hexagon head bolt, unloader cover	SCM435	8	12	16	M8×L35-10.9 (Same as K and L series)	40	400
163	Hexagon head bolt, suction filter cover	SCM435	6	12	12	M16×L55-10.9	120	1200
170L	Hexagon head bolt (No.1), discharge manifold	SCM435	-	3	-	M16×L200-10.9	120	1200
170M	Hexagon head bolt (No.2), discharge manifold	SCM435	8	10	20	M16×L170-10.9	120	1200
170S	Hexagon head bolt (No.3), discharge manifold	SCM435	4	4	4	M16×L120-10.9	120	1200
170C	Hexagon socket head cap screw (No.4), discharge manifold	SCM435	-	1	-	M16×L55-12.9	120	1200
166	Hexagon head bolt, oil sight glass	SCM435	4			M16×L20-10.9	15	150
4	Hexagon socket head cap screw, mechlock	-	10			M12	80	800

7.3 List of Tools for Disassembly

Table 7-3 List of Tools for Disassembly

Tool name	Simplified diagram	Specification/Size	Qty.	Remarks
Socket wrench*1		10 mm 13 mm 17 mm 19 mm 24 mm	1 1 1 1 1	12.7 square drive
Spinner handle*1		300 mm	1	12.7 square drive
Torque wrench*1		50 N•m 100 N•m 200 N•m	1 1 1	12.7 square drive
Hexagon wrench*1		3 mm 5 mm 6 mm 8 mm 10 mm 14 mm	1 1 1 1 1 1	
Spanner*1		10/13 mm 17/19 mm	1 1	
Ratchet handle*1		1/4”	1	
Adjustable wrench*1		250 mm	1	
Needle-nose pliers*1		165 mm		For E-ring
External snap ring pliers*2		200 mm	1	For snap ring H45

Tool name	Simplified diagram	Specification/Size	Qty.	Remarks
Suction disk *3		φ80 mm	1	For attaching piston assembly
Piston ring compressor *3		φ150 mm	1	For attaching piston assembly
Clip *3			4	Suction valve retainer
Stud bolt *3		M16×150 mm	2	Retain the covers
Coupling rod		M20×550 mm	2	For removing/attaching crankshaft
Spacer		φ30—46 mm t30—19 mm	3	For pressing unloader pin
Sponge *1		20×100×100 mm	1	For cleaning
Hose *1		3/8”	1	For supplying/draining refrigerant oil

The tools in the above tool list are used for maintaining this compressor. *3 are tools which will be attached to this compressor.

*1: Marketed product (general tools)

*2: Marketed product (special tools)

*3: MAYEKAWA genuine tools

7.4 Vibration and Sound Data

7.4.1 Vibration

■ Standard Value for Vibration/Applied

The standard value of vibration can be applied when evaluating the vibration of the reciprocating compressor installed in the unit.
Upon the rated rotation speed of the compressor, note that this standard is based on the assumption that the frames and the piping are not resonated.

■ Compressor:

Applies to any of the up/down, right/left, and axial directions of the area around the bearing of the opposite side of load side (oil pump).

■ Standard Value for Vibration Speed

- The vibration severity is defined as the actual value of the vibration speed (mm/s rms).
- It is classified based on the rated output value of the motor connected to the compressor.
- Applies to belt-driven and direct-driven motors.
- When indicating the vibration severity by displacement (D: μm P-P), calculate using the following conversion equation.

  $$D = 30000 \times \sqrt{2} / (\pi N) \cdot Vrms$$

  (N: rotation speed rpm, Vrms: vibration severity of the vibration speed mm/s rms)

- If the value is within the zone of A or B, there is no problem.
- If the value is within the zone of C, related workers must discuss and determine an appropriate response.
- If the value is within the zone of D, stop the operation immediately and investigate.

Table 7-4 Standard value of vibration velocity (mm/s rms)

A: Great, B: Good, C: Attention, D: Not applicable

Range of vibration severity		Range of Motor Rated Output					
		Retained base			Vibration Absorbing base		
Category	Vibration Speed RMS Value (mm/s rms)	Below 50 kW	50 kW — 100 kW	100 kW or over	Below 50 kW	50 kW — 100 kW	100 kW or over
1.1	1.12	A/B	A/B	A/B	A/B	A/B	A/B
1.8	1.78						
2.8	2.82						
4.5	4.46						
7.1	7.07	C					
11	11.2		C		C		
18	17.8	D		C		C	
28	28.2		D		D		C
45	44.6			D		D	
71	70.7						D

7.4.2 Sound Data

■ Measurement Position of Sound Data

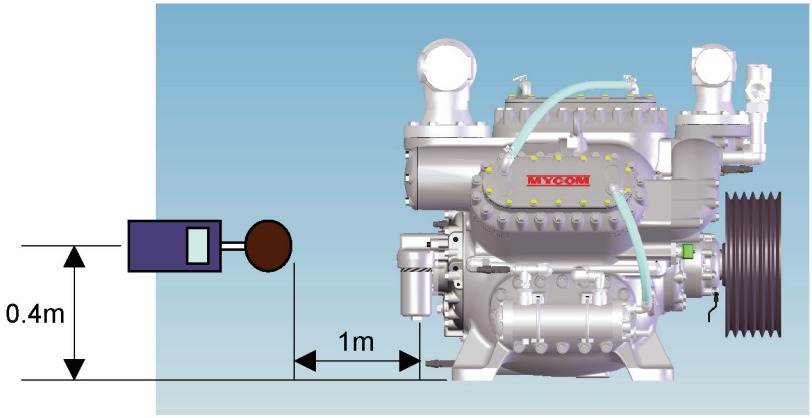


Fig. 7-7 Measurement position of sound data (6M)

■ Measurement Condition and Sound Data (For Reference)

Table 7-5 Measurement condition and value of sound data (NH_3, Tc/Te=35/–15°C)

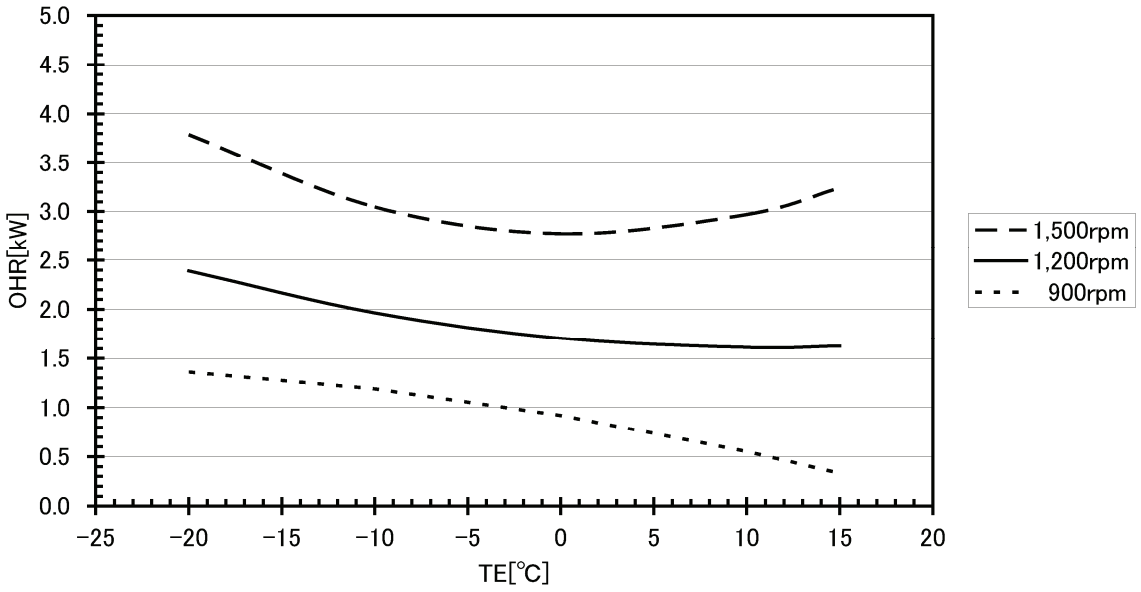
			4M				6M				8M				62M			
Refrigerant			NH_3				NH_3				NH_3				NH_3			
Suction pressure		(MpaA)	0.237												0.054			
Discharge pressure		(MpaA)	1.35															
Rotation speed		(rpm)	800	1000	1200	1500	800	1000	1200	1500	800	1000	1200	1500	800	1000	1200	1500
Sound data	Sound pressure level	(dB(L))	85	88	88	92	85	88	92	92	85	88	92	93	89	90	88	90
	Noise level	(dB(A))	84	86	87	90	84	86	90	89	85	87	91	90	88	89	87	89
	Acoustic power level	(dB(A))	92	94	95	98	92	94	98	97	93	95	99	98	96	97	95	97

【POINT】

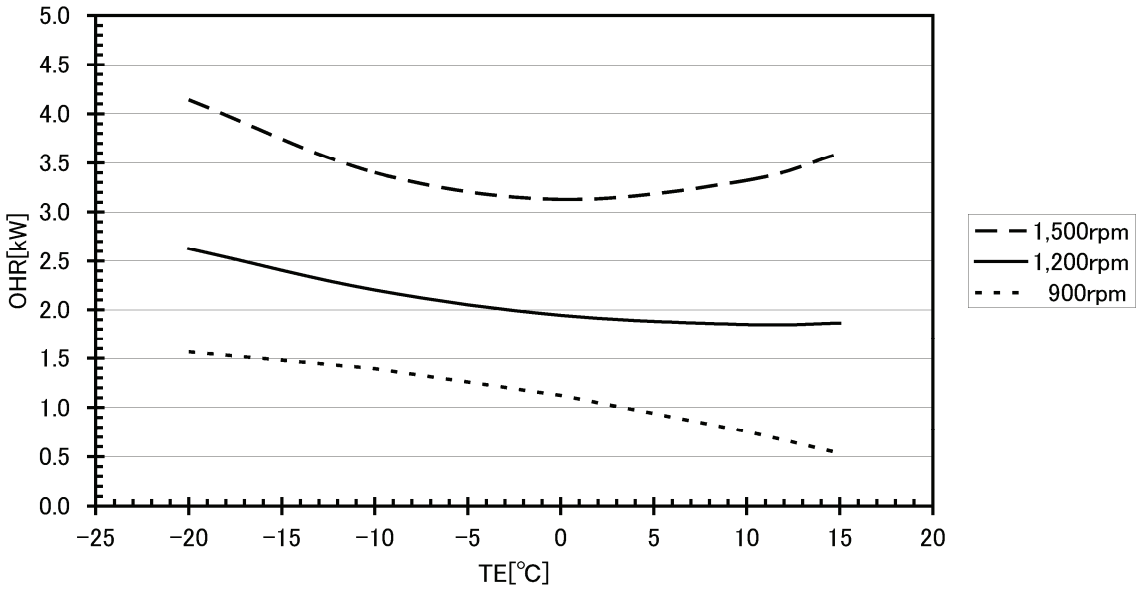
- The description above is created upon measurement data of the test machine. The values above are reference values. Actual sound data of the machine after installation may vary from the values above.

7.5 Oil Cooler Heat Rejection (OHR)/Head Jacket Heat Rejection (JHR) (N4M, N6M, N8M)

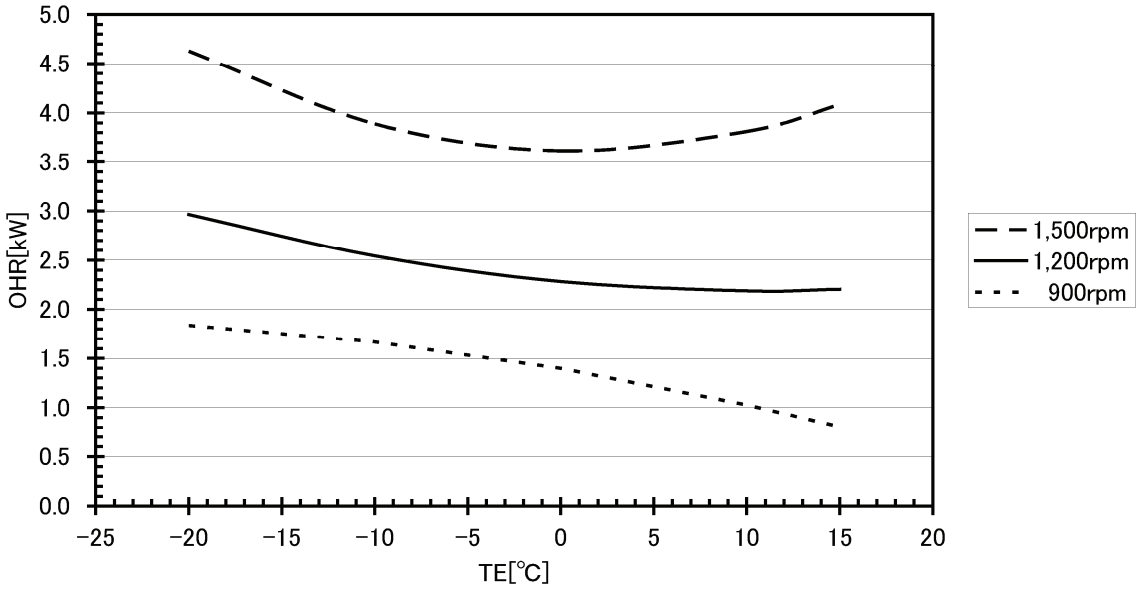
N4M OHR
NH_3, TC=30℃



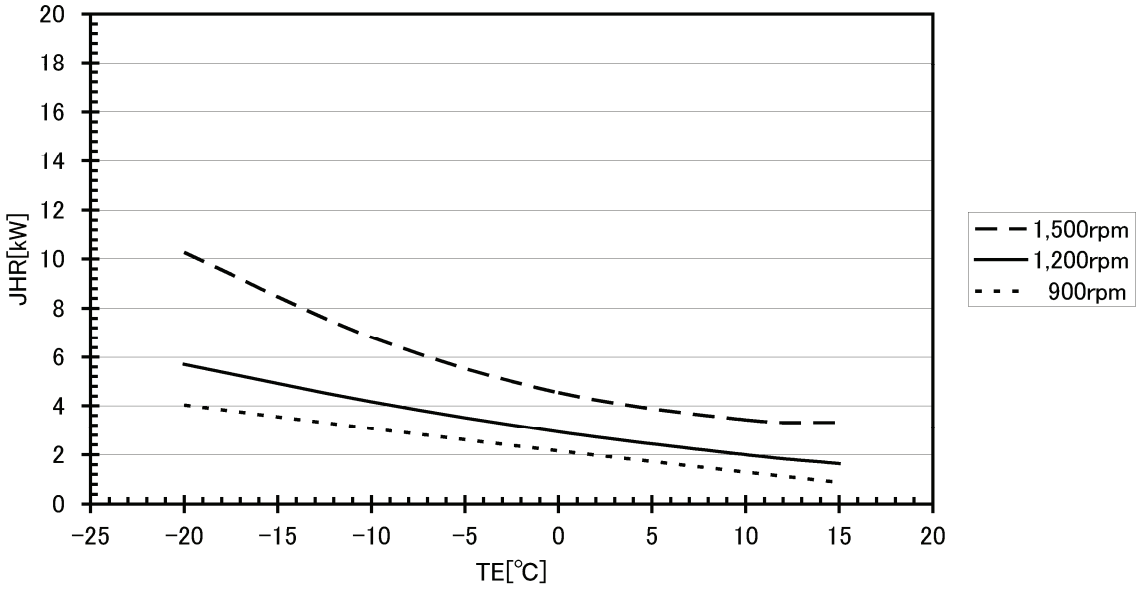
N4M OHR
NH_3, TC=35℃



N4M OHR
NH_3, TC=40℃



N4M JHR
NH_3, TC=30℃



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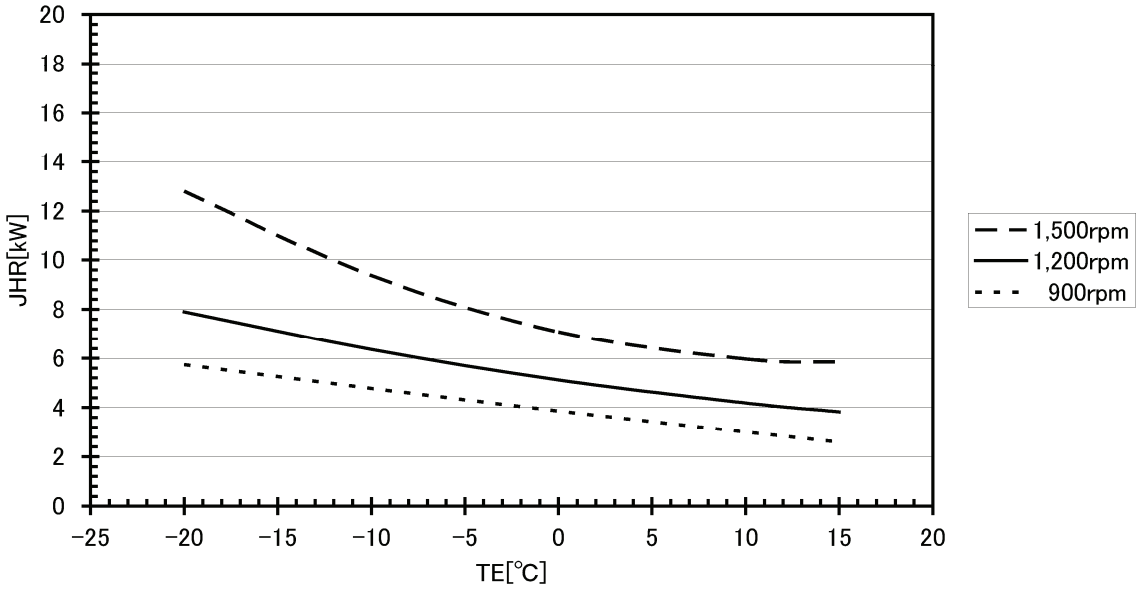
NH_3, TC=35℃



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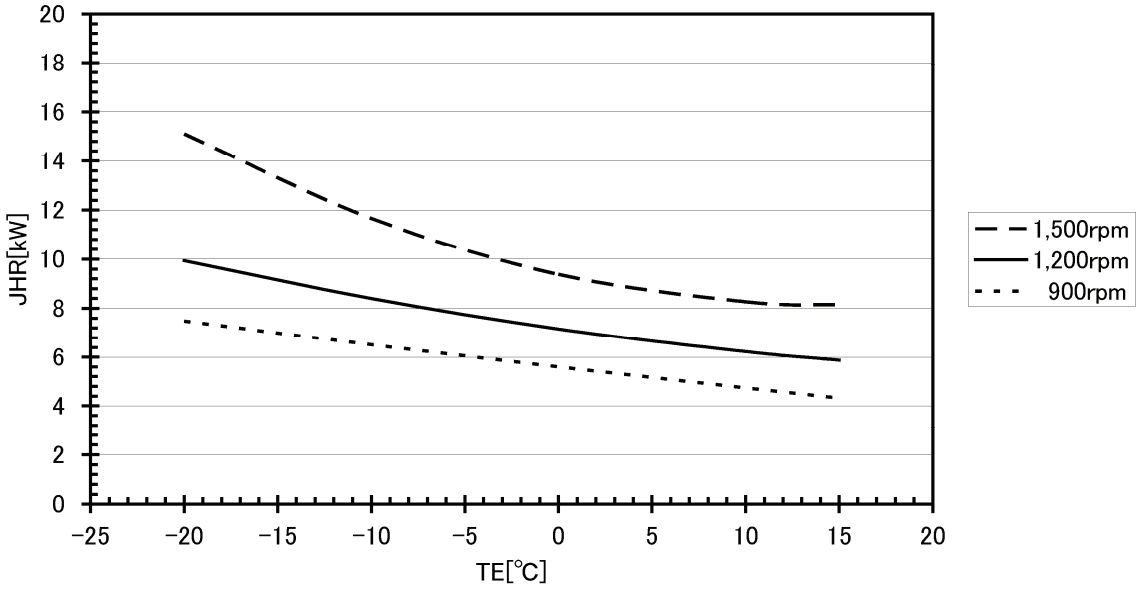

N6M OHR
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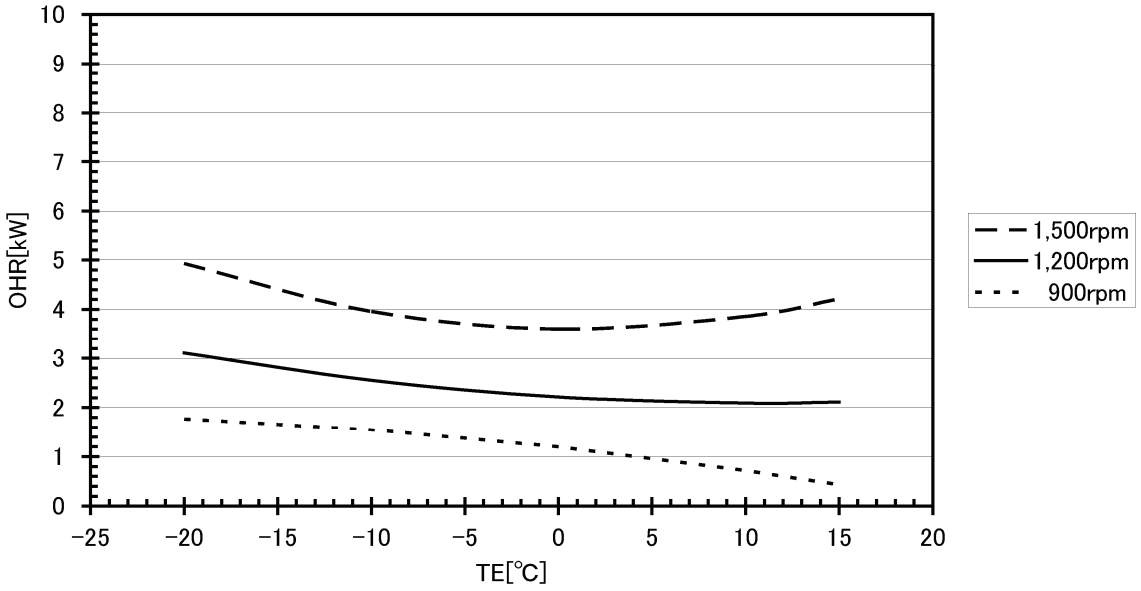

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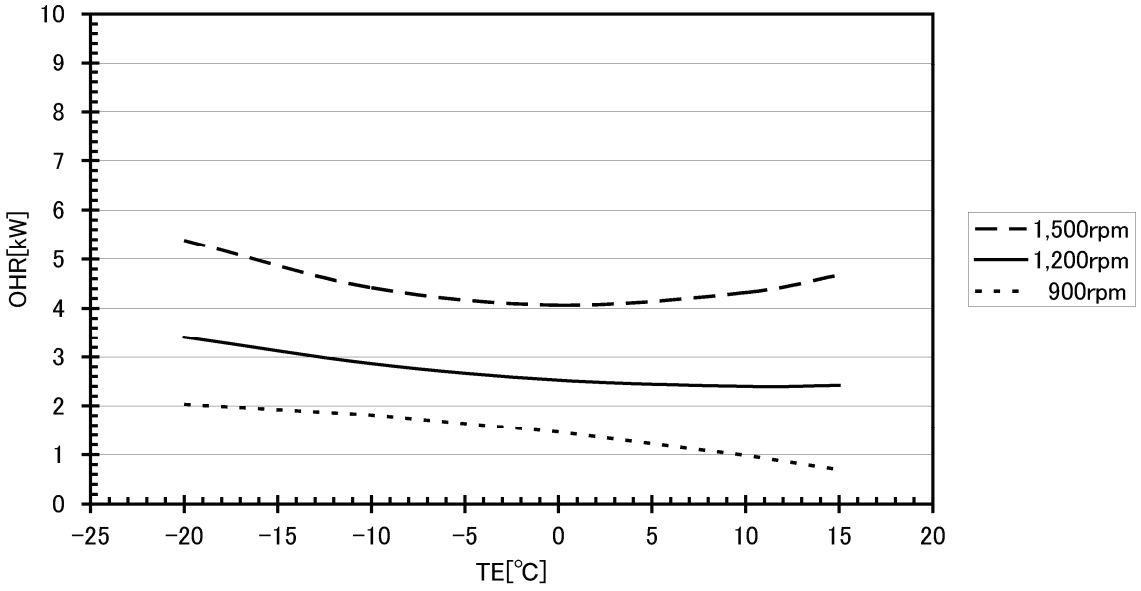

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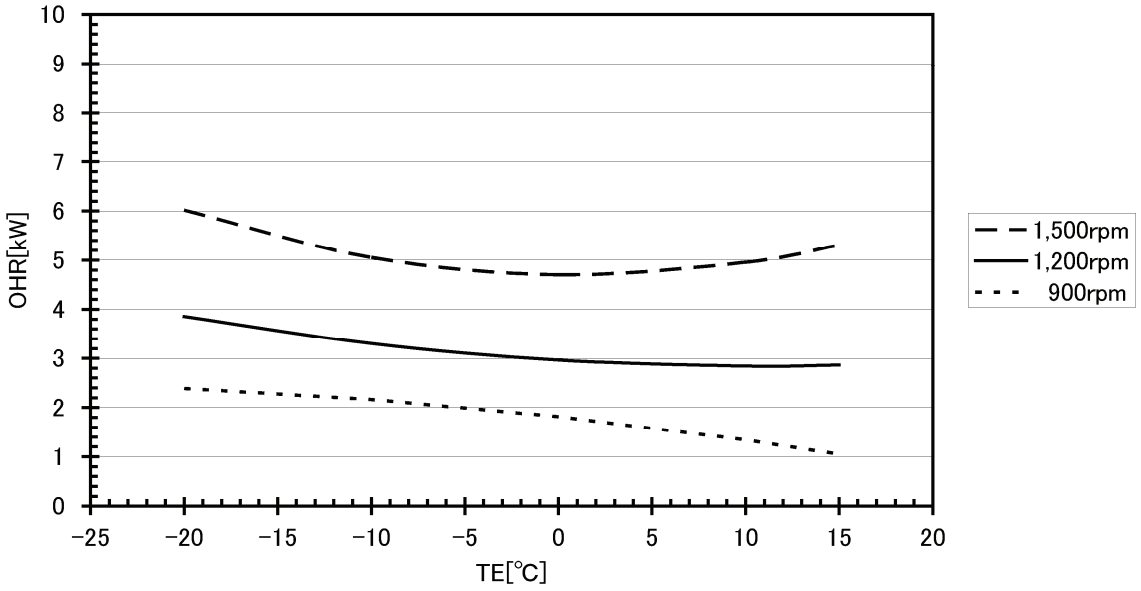

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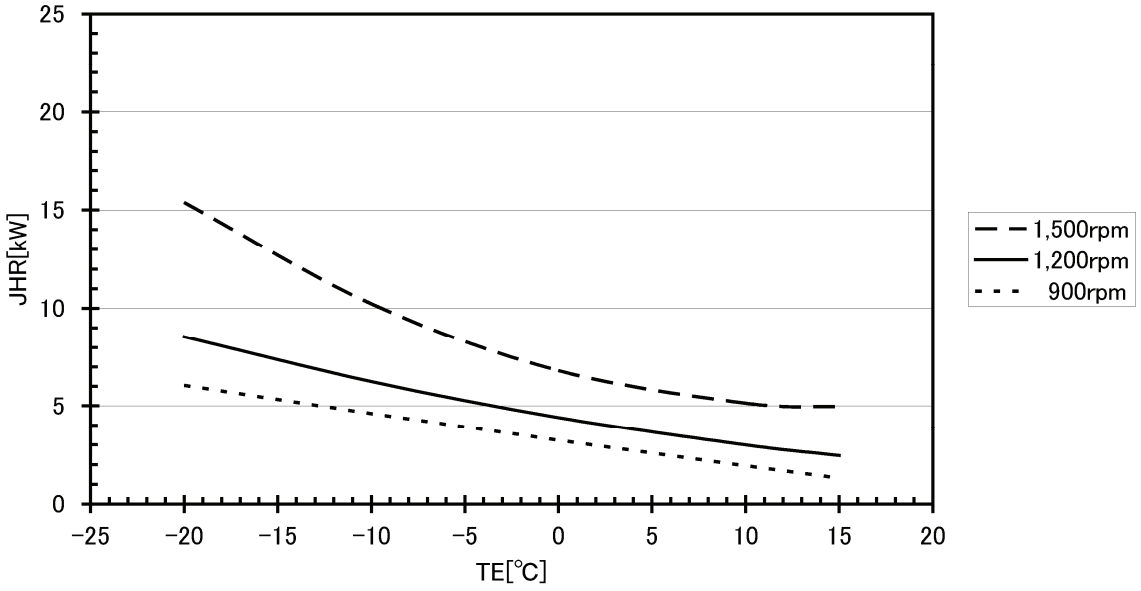

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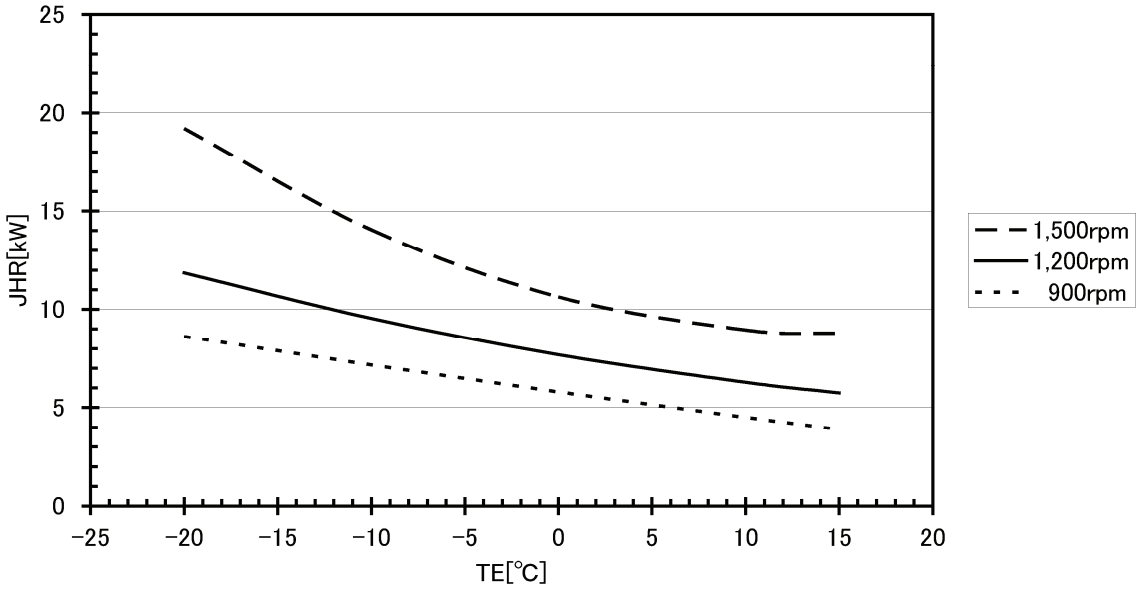

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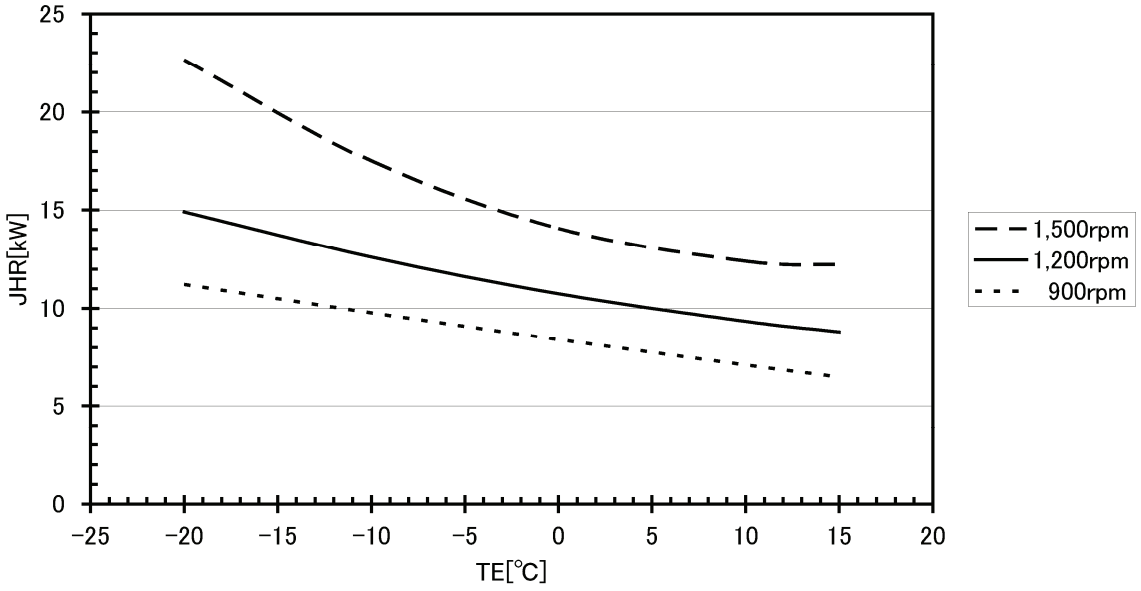
NH_3, TC=40℃



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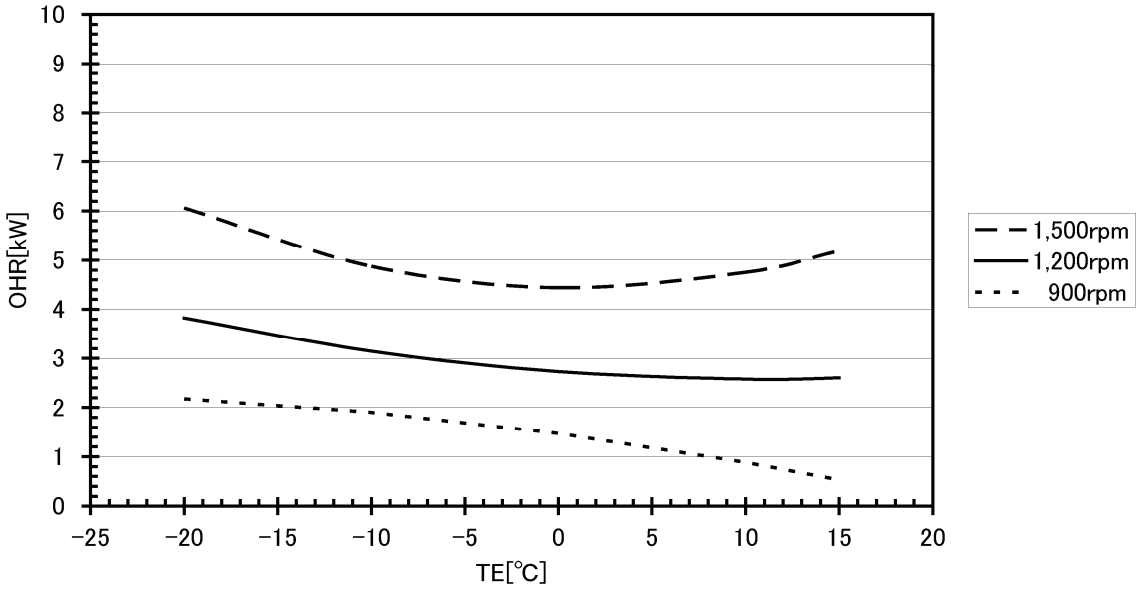

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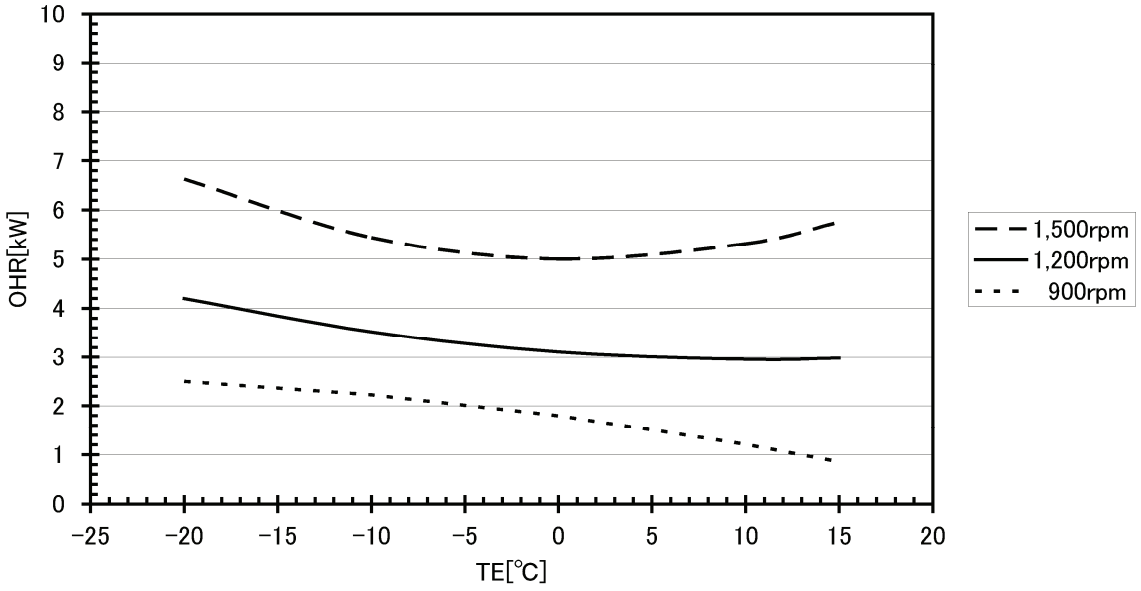

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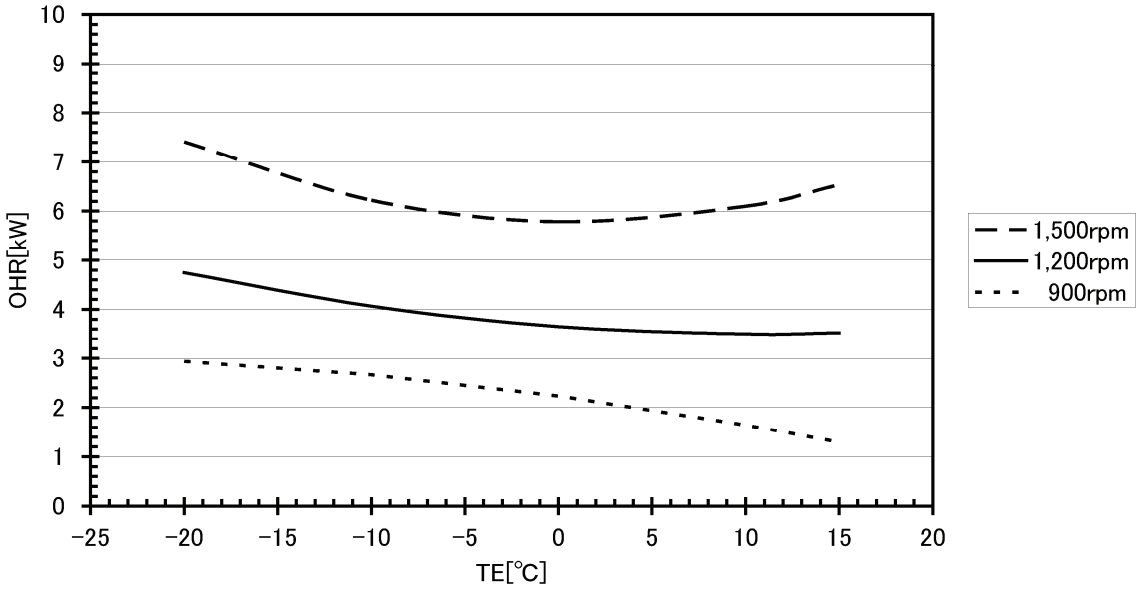

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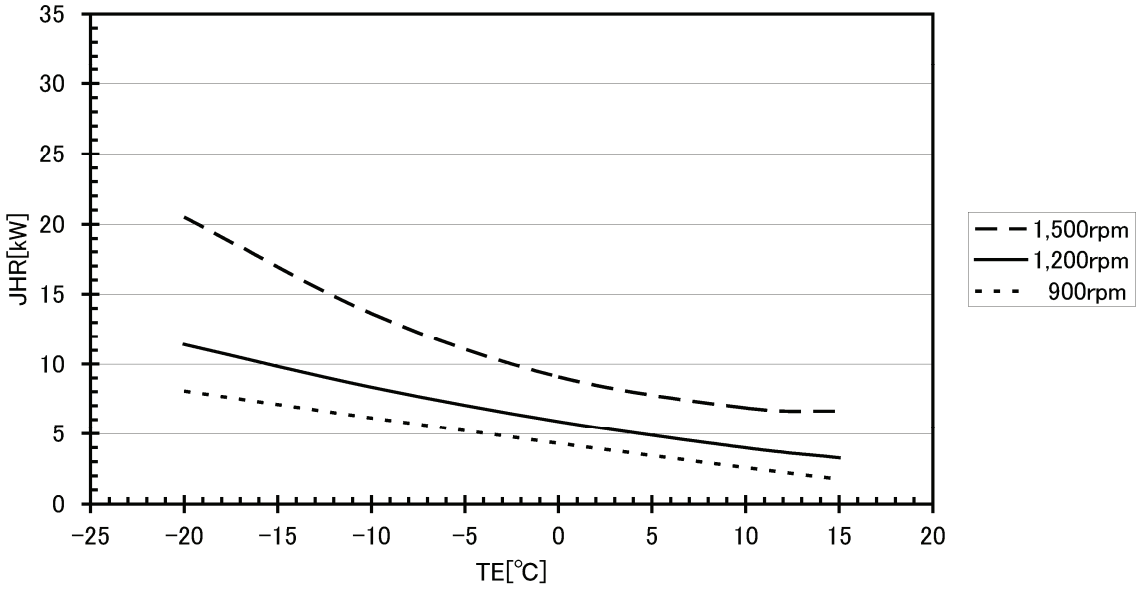
NH_3, TC=30℃



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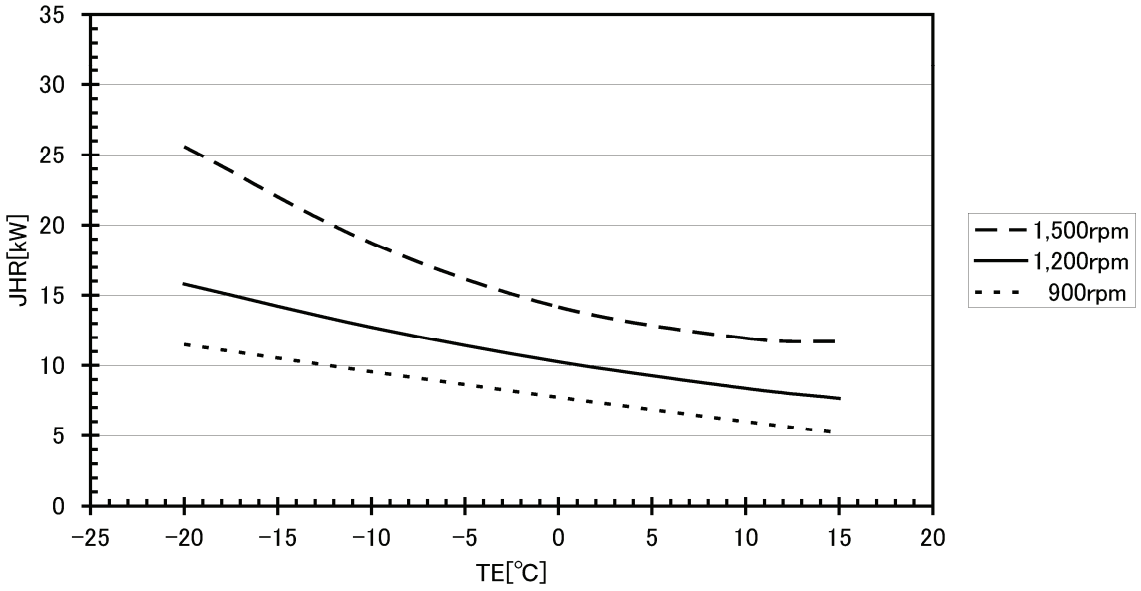
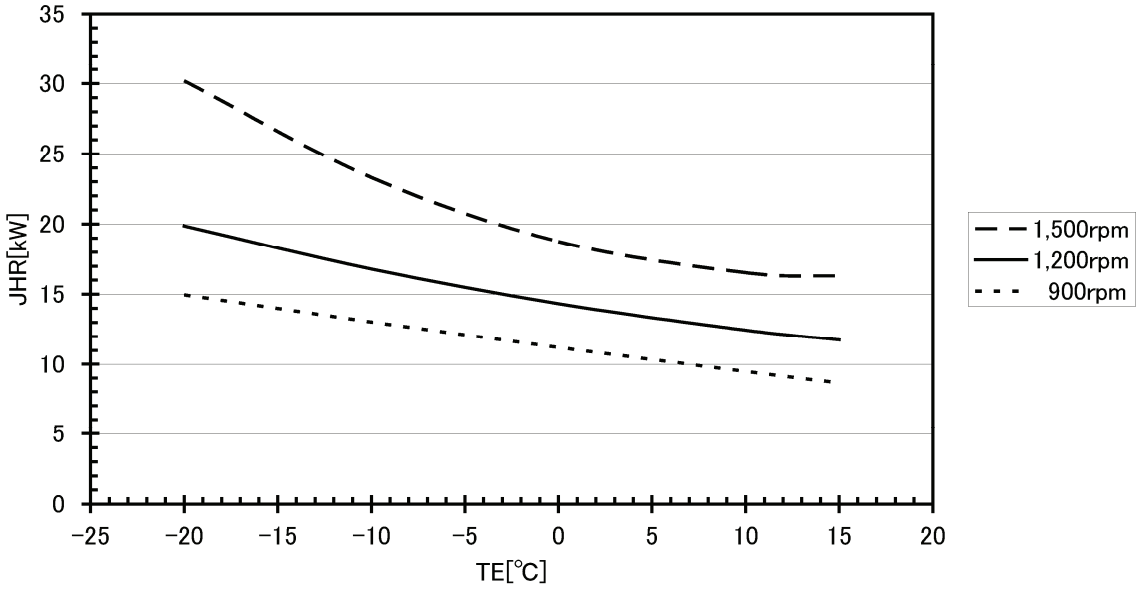
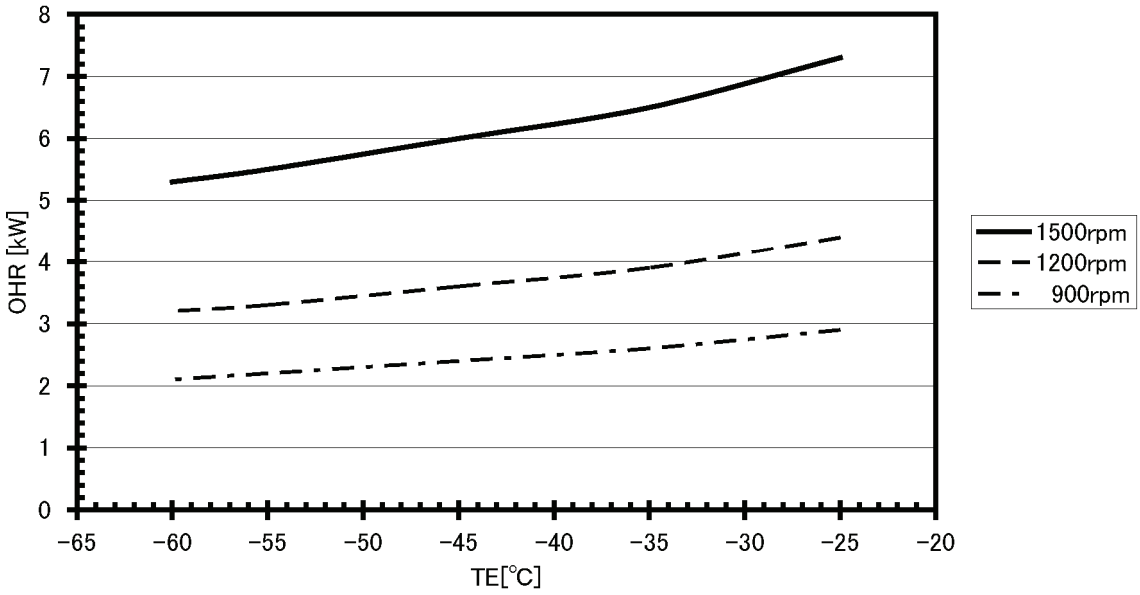
NH_3, TC=35℃



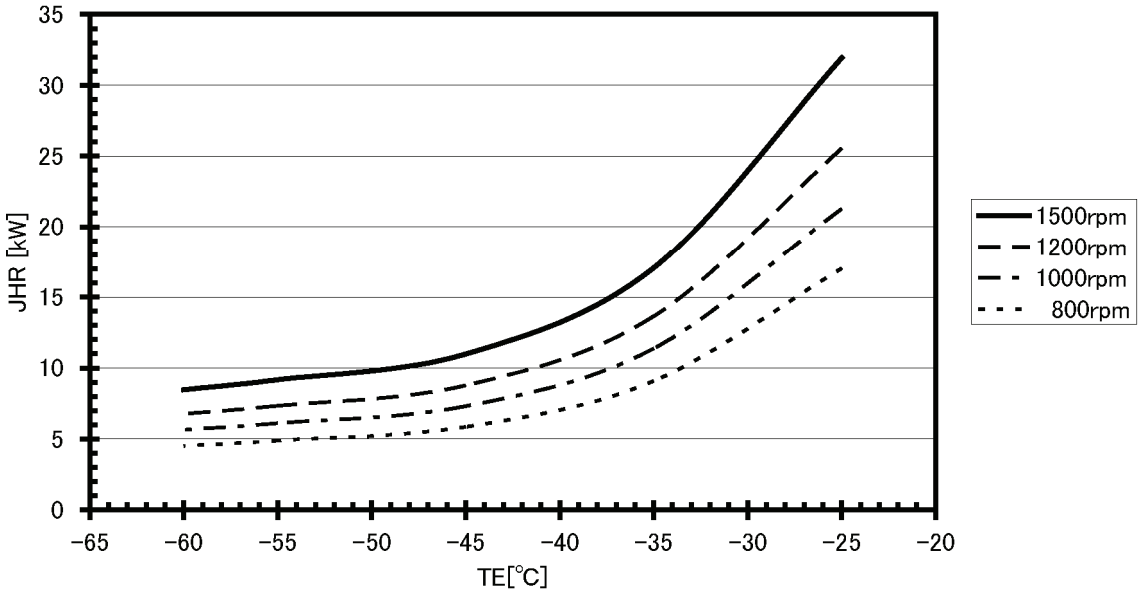
N8M JHR
NH_3, TC=40℃



N62M OHR
NH3、Tc=30～40℃



N62M JHR
NH3、Tc=30～40℃



7.6 Starting Torque

■ Starting Condition

The standard load percentage for starting the M series single-stage compressor is 0%.
The value is for the direct-driven motors. For belt-driven motors, the value increases by approx. 50%.

■ Characteristics of Starting Torque

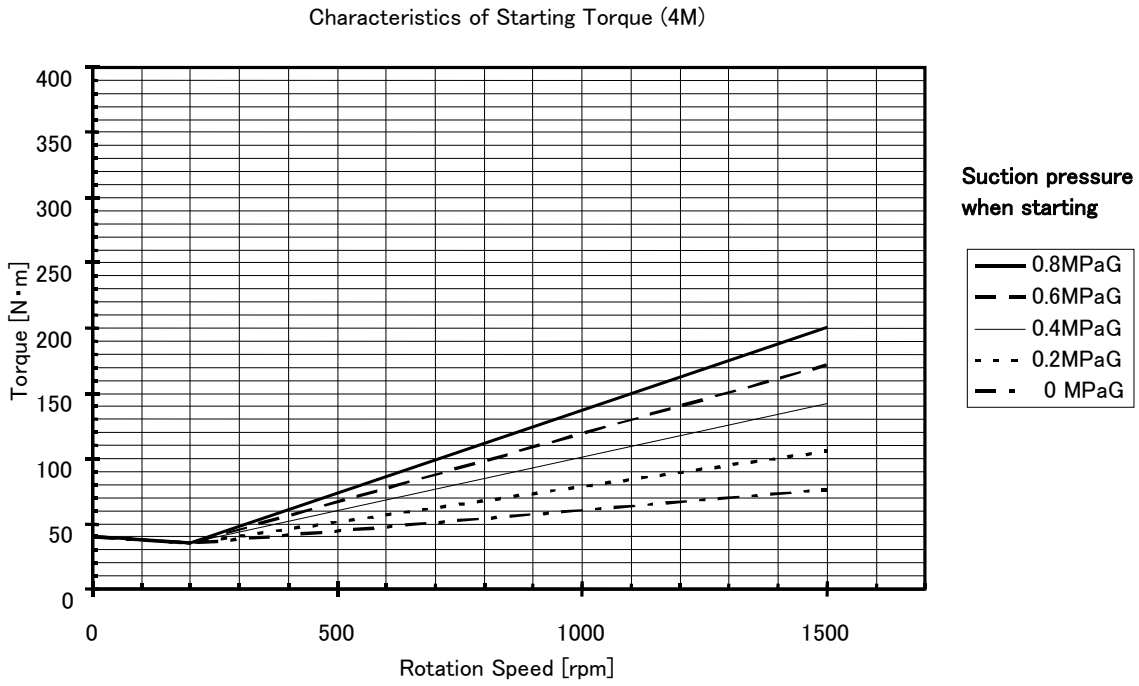


Fig. 7-8 Characteristics of starting torque (4M)

Table7-6 Characteristics of starting torque (4M)

	Rotation speed (rpm)	Suction pressure when starting [MpaG]				
		0	0.2	0.4	0.6	0.8
		Torque [N·m]				
Tb	0	40	40	40	40	40
Tbl	200	35	35	35	35	35
Tu	1500	76	106	142	172	201

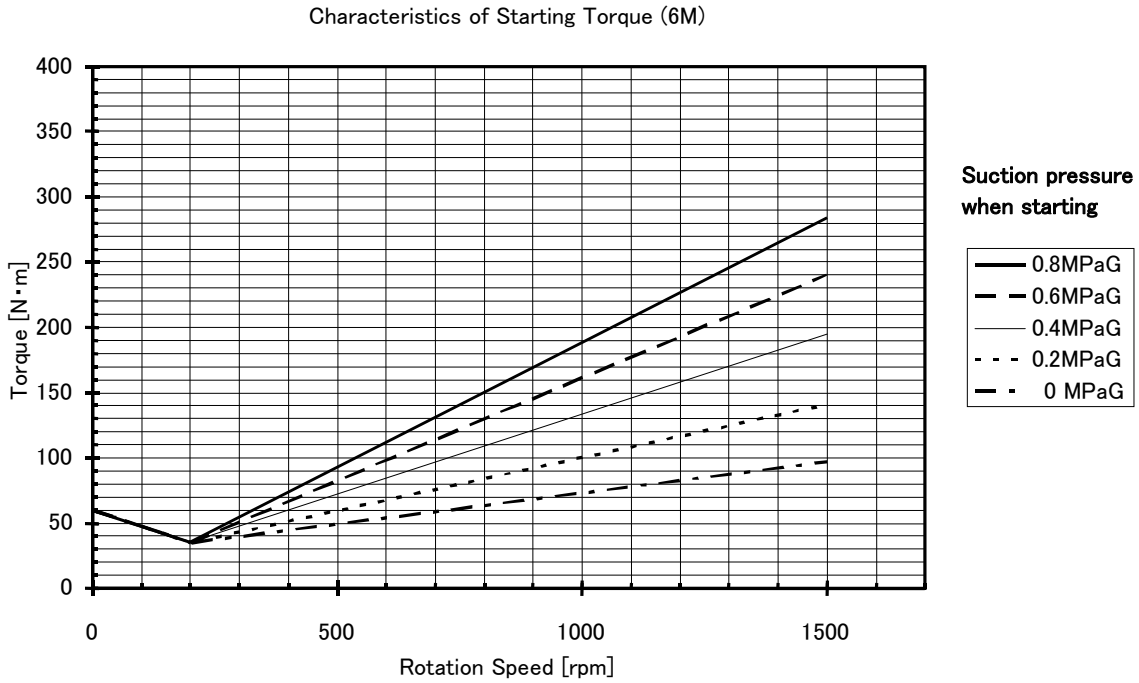


Fig. 7-9 Characteristics of starting torque (6M)

Table 7-7 Characteristics of starting torque (6M)

	Rotation speed (rpm)	Suction pressure when starting [MpaG]				
		0	0.2	0.4	0.6	0.8
		Torque [N·m]				
Tb	0	60	60	60	60	60
Tbl	200	35	35	35	35	35
Tu	1500	97	141	195	240	284

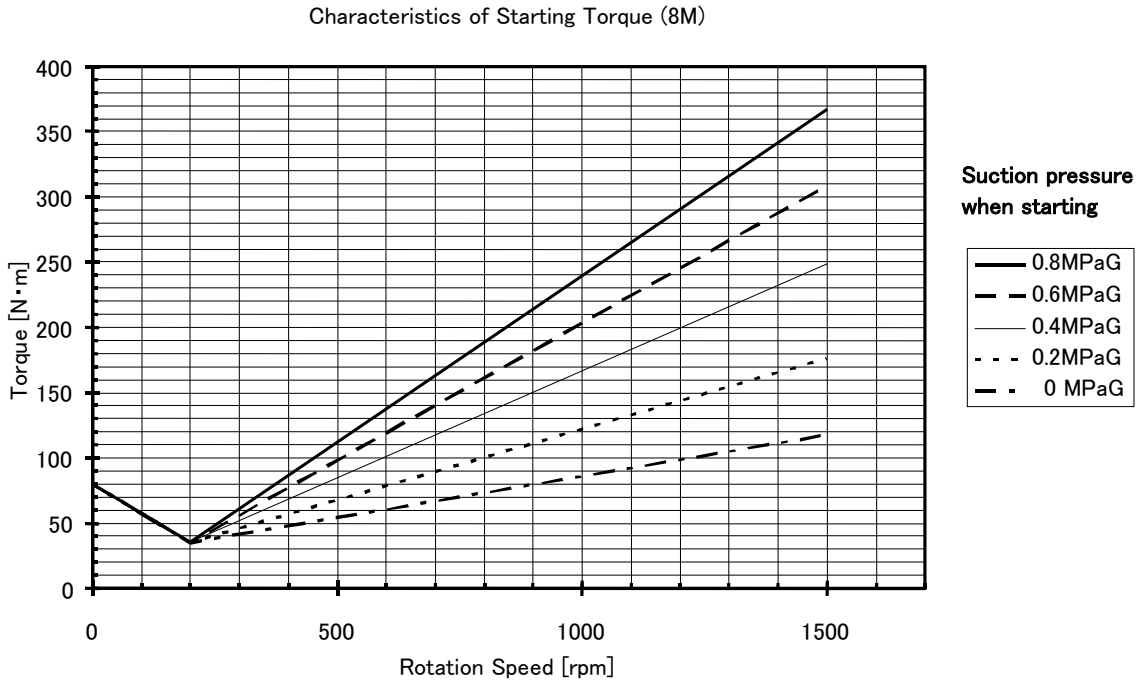


Fig. 7-10 Characteristics of starting torque (8M)

Table 7-8 Characteristics of starting torque (8M)

	Rotation speed (rpm)	Suction pressure when starting [MpaG]				
		0	0.2	0.4	0.6	0.8
		Torque [N·m]				
Tb	0	80	80	80	80	80
Tbl	200	35	35	35	35	35
Tu	1500	118	176	248	308	367

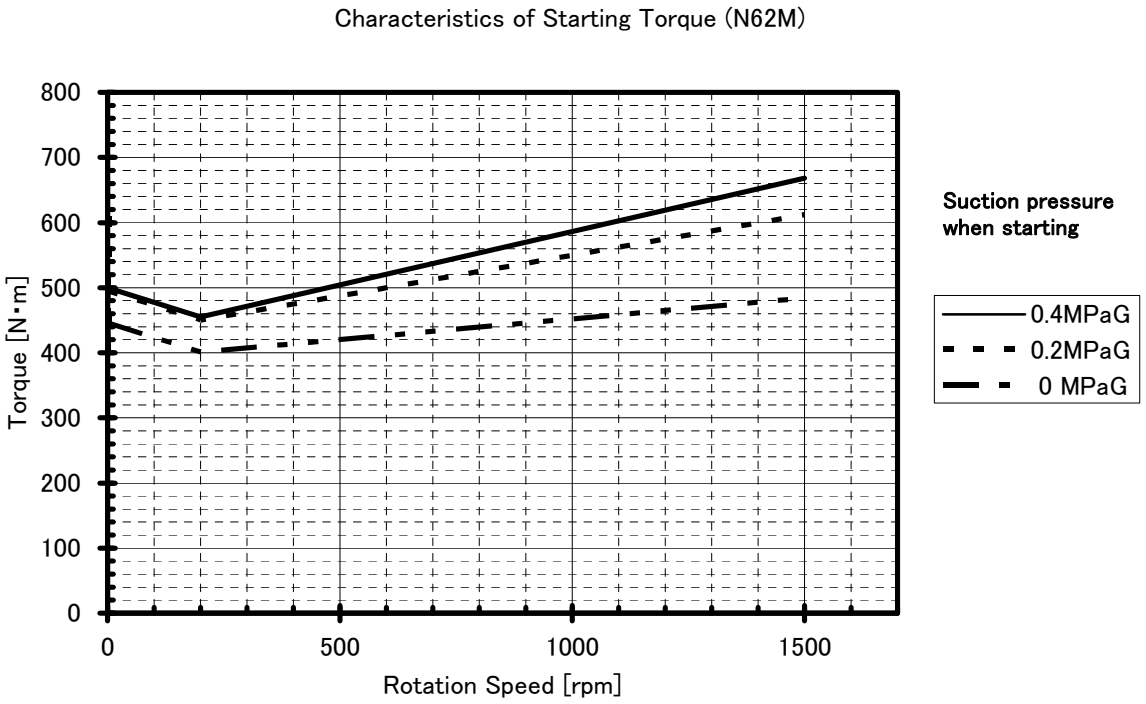


Fig. 7-11 Characteristics of starting torque (62M)

Table 7-9 Characteristics of starting torque (62M)

	Rotation speed (rpm)	Suction pressure when starting [MpaG]		
		0	0.2	0.4
		Torque [N·m]		
Tb	0	446	495	500
Tbl	200	401	450	455
Tu	1500	484	612	668

* The starting torque will be 1.1 times the one of 8M when starting with starting pressure equalizer.

7.7 Parts Inspection and Replacement Standards

■ Suction Filter/ Oil Strainer/ Oil Filter

1. When cleaning the metallic mesh, inspect if the meshes are torn or soldered part is separated.
If defects are found, always repair or replace it with a new one.

【POINT】

- Special flux must be used for soldering stainless steel parts.

2. If plugs the fine net and cannot be cleaned, blow the dust off with the compressed air from the direction opposite of the fluid flow.

3. Suction filter/oil strainer is a cylindrical shaped filter with plicate which has a large pass area. If the filter is clogged, blow it off with the compressed air from inside.

4. If the oil filter is clogged, replace it.

■ Crankshaft

1. Inspect each bearing axes of the crankshaft for wear.
If it is worn, the sliding section and non-sliding section of the bearing axis will become uneven. Inspect visually and by touching it with your hand.
Measure the diameter of each bearing axis at the worn part using a macro meter.
If the diameter is below the usage limit, replace the crankshaft.

Measurement point	Standard dimensions (mm)	Usage limit (mm)
Diameter of main bearing	110	109.88
Diameter of thrust bearing	125	124.86
Diameter of crank pin	107	106.85

2. Inspect each sliding section of the crankshaft for scratches.
If scratches are found, repair it by using sandpaper (#800 or more) or a grinding stone.

3. Remove all the plugs attached to the crankshaft and clean the oil holes.
After cleaning the oil holes, check that the oil flows properly.
Reattach the plugs immediately after checking the oil holes. If the plugs are not replaced damage to the crankshaft will occur.

4. Inspect the mechanical seal attachment section of the crankshaft for scratches.
If scratches are found, repair it by using sandpaper (#800 or more) or an oilstone.

■ Connecting Rod

1. Inspect the surface of the bearing halves assembled to the large end of the connecting rod for foreign materials.
If there are foreign materials on the surface of the bearing halves, replace them.

2. Measure the thickness of the center part of the bearing halves.
If the thickness is below the usage limit, replace the bearing halves.

Measurement point	Standard dimensions (mm)	Usage limit (mm)
Thickness of the center part of the bearing halves	2.5	2.34

3. Measure the inner diameter of the shaft hole at the small end of the connecting rod.
If the inner diameter of the shaft hole exceeds the usage limit, replace the connecting rod bushings.

Measurement point	Standard dimensions (mm)	Usage limit (mm)
Inner diameter of the shaft hole at the small end of the connecting rod	45	45.1

■ Cylinder sleeve

1. Inspect the surface of the suction valve seat on the top of cylinder sleeve for scratches.
If there are scratches on the surface of the valve seat, repair them by lapping.

2. Measure the height of the valve seat section. (Refer to Fig. 7-12)
If the height of the valve seat section exceeds the usage limit, replace the cylinder sleeve.

Measurement point	Standard dimensions (mm)	Usage limit (mm)
Height of valve seat section of cylinder sleeve: **A**	0.5	0.2

3. Inspect the inner surface of the cylinder sleeve for scratches.
If scratches are found in the inner surface, repair it by using a smooth grinding stone.

4. Measure the inner diameter of the cylinder.
If the inner diameter of the cylinder exceeds the usage limit, replace the cylinder sleeve.

【POINT】

- The section 5—7 mm from the top of the inner surface of the cylinder sleeve is the section most worn.

Measurement point	Standard dimensions (mm)	Usage limit (mm)
Inner diameter of the cylinder	146	146.2

■ Discharge Valve (Assembly)/ Suction Valve (Assembly)

1. Replace the discharge plate valve, suction plate valve, and valve spring periodically. The endurance time depends on the use condition.
Measure the depth of the wear at the contact surface to valve seat. (Refer to Fig. 7-12)
If the contact surface to valve seat is worn for 0.15 mm or more, replace the discharge plate valve, suction plate valve, and valve spring.

Measurement point	Standard dimensions (mm)	Wear limit (mm)
Depth of the wear at the contact surface to valve seat of discharge plate valve: **B** Depth of the wear at the contact surface to valve seat of suction plate valve : **C**	—	0.15

2. Inspect the surface of the inner/outer periphery of the discharge plate valve and suction plate valve for scratches.
If there are scratches on the surface of the inner/outer periphery, replace the discharge plate valve and suction plate valve.

【POINT】

- Though wear of contact surface to valve seat of the discharge plate valve and suction plate valve are within the wear limit, if there are scratches on the surface of inner/outer periphery, fatigue crack on the valves may result.

3. Measure the height of the valve seat section of valve plate and discharge valve seat. (Refer to Fig. 7-12)
If the height of the valve seat section becomes 0.15 mm or less, replace the valve plate and the discharge valve seat.

Measurement point	Standard dimensions (mm)	Usage limit (mm)
Height of the discharge valve seat: **D** Height of the valve plate seat: **E**	0.5	0.15

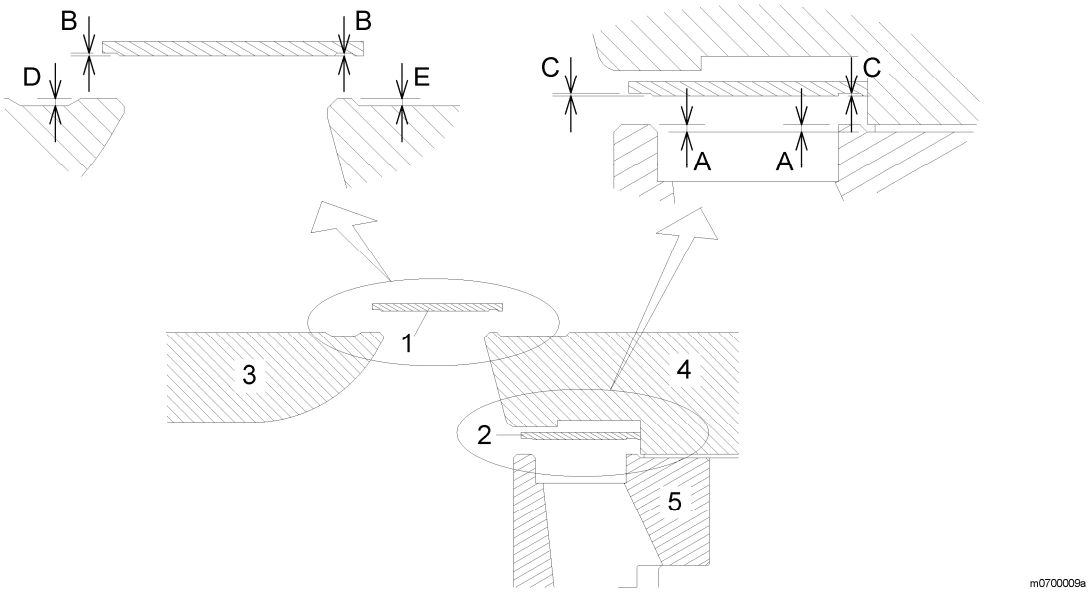


Fig. 7-12 Measurement positions of seat

No.	Description
1	Discharge plate valve
2	Suction plate valve
3	Discharge valve seat

No.	Description
4	Valve plate
5	Cylinder sleeve

■ Mechanical Seal

1. Inspect the sliding surface of the mechanical seal (retaining ring) and the mechanical seal (rotating ring).
If the sliding surface is lustrous, the mechanical seal is in a good condition.
If the sliding surface is uneven, replace the mechanical seal as an assembly.

2. Inspect the sliding surface of the floating seat for chips and cracks.
If the sliding surface is chipped or cracked, replace the mechanical seal as an assembly.

3. Replace the "O"ring when disassembling and inspecting.

■ Piston/ Piston Pin/ Piston Ring

1. Inspect the piston for scratches.
If scratches are found, repair it by using a grinding stone.
If scratches are found in the outer surface, repair it by grinding the surface at a right angle of the sliding direction, using a grinding stone.

2. Measure the outer diameter of the piston skirt section.
If the outer diameter is below the usage limit, replace the piston.

Measurement point	Standard dimensions (mm)	Usage limit (mm)
Outer diameter of the piston skirt section	146	145.6

3. Floating system is adopted for piston pin hole and the piston pin of the piston.
Measure the inner diameter of the piston pin hole.
If the inner diameter exceeds the usage limit, replace the piston.

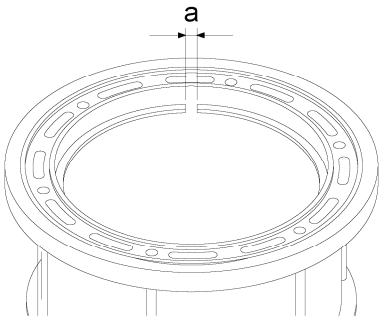
Measurement point	Standard dimensions (mm)	Usage limit (mm)
Inner diameter of the piston pin	45	45.1

4. Measure the outer diameter of the piston pin.
If the outer diameter is below the usage limit, replace the piston pin.

Measurement point	Standard dimensions (mm)	Usage limit (mm)
Outer diameter of the piston pin	45	44.93

5. Check the wear condition of the piston ring by measuring the abutment joint interval (a).
Place the piston ring at a position of approx. 3 mm from the top of the cylinder sleeve and measure the abutment joint interval (a).
If the abutment joint interval (a) exceeds the usage limit, replace the piston ring.

Measurement point	Standard dimensions (mm)	Usage limit (mm)
Abutment joint interval of the piston ring (1st, 2nd, and 3rd)	0.3～0.5	2.5



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6. Measure the width of the piston ring groove of the piston.
If the width exceeds the usage limit, replace the piston.

Measurement point		Standard dimensions (mm)	Usage limit (mm)
Width of the piston ring groove of the piston	1st	2.5	2.6
	2nd	2.0	2.1
	3rd	3.0	3.1

■ Oil Pump

If the oil pressure is low though the oil pressure adjustment valve is closed during the operation, and if the cause is not the clogging of the oil filter, there may be wear on the gears, metals, and shafts of the oil pump.

1. Remove the pump from the compressor, hold the shaft of the pump, and inspect the shaft for looseness by moving it to the axial direction or right angle of the axial direction.
If the shaft is loosened, replace the oil pump as an assembly.

■ Main Bushing

1. Measure the inner diameter of the main bushing.
If the inner diameter exceeds the usage limit, replace the main bushing.

Measurement point	Standard dimensions (mm)	Usage limit (mm)
Inner diameter of the main bushing (seal side)	125	125.36
Inner diameter of the main bushing (pump side)	110	110.36

2. Measure the thickness of the thrust washer.
If the thickness is below the usage limit, replace the thrust washer.

Measurement point	Standard dimensions (mm)	Usage limit (mm)
Thickness of the thrust washer	3.0	2.8

■ Springs

Replace the discharge valve spring and suction valve spring periodically.

■ Gasket List

CAUTION

- **Gaskets cannot be reused. Always replace with a new gasket.**

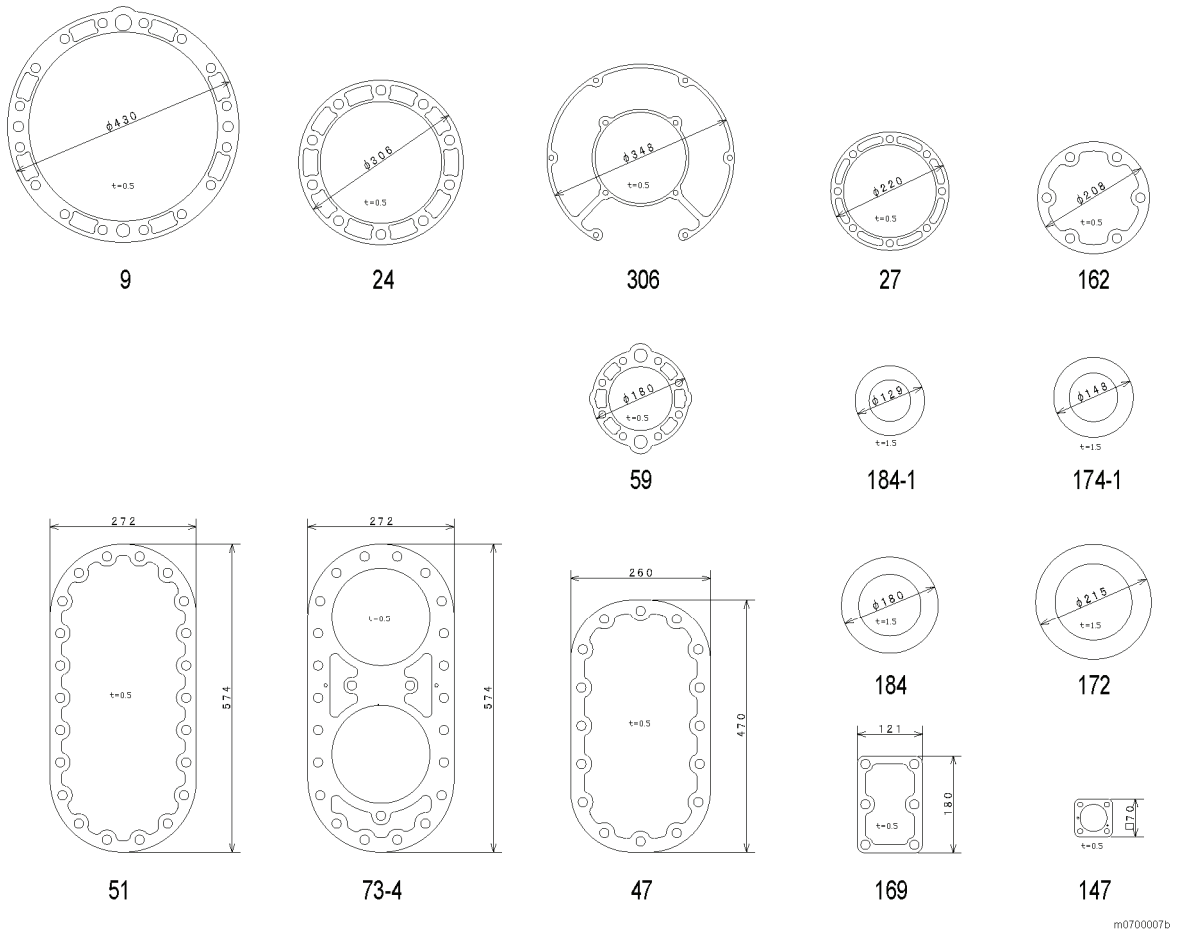

Fig. 7-13 Gasket list

Part Number	Part name	Material	Qty.				Remarks
			4M	6M	8M	62M (std)	
9	Gasket, main bearing head	Asbestos-free	1				
24	Gasket, bearing head	Asbestos-free	1				
27	Gasket, shaft seal cover	Asbestos-free	1				
47	Gasket, hand hole cover	Asbestos-free	2				
51	Gasket, head cover	Asbestos-free	2	3	4	4	
59	Gasket, oil pump	Asbestos-free	1				
73-4	Gasket, valve plate	Asbestos-free	2	3	4	4	
147	Gasket, unloader cover	Asbestos-free	2	3	4	2	Same as K and L series
162	Gasket, suction filter cover	Asbestos-free	1	2	2	2	
169	Gasket, discharge manifold	Asbestos-free	2	3	4	4	
172	Gasket, Shut-off valve	Asbestos-free	-	1	2	-	125A(ANSI#300),t1.5
184	Gasket, Shut-off valve	Asbestos-free	2	1	-	1	100A(ANSI#300),t1.5
174-1	Gasket, Shut-off valve	Asbestos-free	-	-	-	2	80A(ANSI#300),t1.5
184-1	Gasket, Shut-off valve	Asbestos-free	-	-	-	1	65A(ANSI#300),t1.5
306	Gasket, blow-by gas plate	Asbestos-free	1				

■ “O”ring List

CAUTION

- **“O”rings cannot be reused. Always replace with a new “O”ring.**

Fig. 7-14 “O” ring list

Part Number	Part name	Material	Qty.				Type	Width mm	Inner diameter (W) mm	Outer diameter (W) mm
			4M	6M	8M	62M (std)				
14-2	“O”ring, oil filter element	NBR	2				AS568 -222	3.53	37.69	44.75
14-3	“O”ring, oil filter case	NBR	1				JISB2401 G90	3.1	89.4	95.6
15	“O”ring, Oil filter head	NBR	2				JISB2401 G25	3.1	24.4	30.6
24-1	“O”ring, bearing head	NBR	1				JISB2401 G200	5.7	199.3	210.7
37	“O”ring, oil seal retainer	NBR	1				JISB2401 G160	5.7	159.3	170.7
39	“O”ring, mechanical seal collar	NBR	1				AS568 -245	3.53	110.72	117.78
41-2	“O”ring, shower flushing sleeve	NBR	2				AS568 -257	3.53	148.82	155.88
42	“O”ring, mechanical seal mating ring	NBR	1				JISB2401 P130	5.7	129.6	141
67	“O”ring, cylinder sleeve	NBR	4	6	8	8	AS568 -258	3.53	151.99	159.05
~~145-1~~	~~"O"ring, unloader piston~~	~~NBR~~	~~2~~	~~3~~	~~4~~	~~2~~	~~JISB2401 G35~~	~~3.1~~	~~34.4~~	~~40.6~~
154-1	"O"ring, suction filter	NBR	1	2	2	2	JISB2401 P100	5.7	99.6	111
165	"O"ring, oil sight glass	NBR	1				AS568 -137	2.62	52.07	57.31